



Forest Service
U.S. DEPARTMENT OF AGRICULTURE

MB-R3-04-37
Southwestern Region

March 2022
Apache-Sitgreaves, Coconino, and Tonto National Forests

4FRI Rim Country Project

Final Environmental Impact Statement

Volume 1



Cover photo: Storm on the Rim, Apache-Sitgreaves National Forests

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**4FRI Rim Country Project
Final Environmental Impact Statement**

Apache-Sitgreaves, Coconino, and Tonto National Forests
Apache, Coconino, Yavapai, Gila, and Navajo Counties, Arizona

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Abstract: The Four Forest Restoration Initiative (4FRI) covers portions of four national forests in Arizona. The first 4FRI Environmental Impact Statement (EIS) was completed and the Record of Decision was signed in 2015. Implementation of the treatments analyzed in the first EIS are currently being implemented. The 4FRI Rim Country Project analysis continues this collaboration effort. This final environmental impact statement (FEIS) documents the analysis of three alternatives that consist of Alternative 1 (No Action), Alternative 2 (Modified Proposed Action) that is the preferred alternative, and Alternative 3 (Focused Restoration), which were developed for the Rim Country Project on the Apache-Sitgreaves, Coconino, and Tonto National Forests. The action alternatives vary in the amount of mechanical and prescribed fire treatments over a 20-year period or until proposed activities are complete. Both action alternatives propose a project-specific amendment to the 1985 Tonto National Forest Land Management Plan.

List of Acronyms

4FRI	Four Forest Restoration Initiative	dPFA	Dispersal post-fledging area
ACHP	Advisory Council on Historic Preservation	DRC	Diameter at root collar
ADEQ	Arizona Department of Environmental Quality	EIS	Environmental impact statement
AGFD	Arizona Game and Fish Department	EMA	Ecosystem management area
AUM	Animal Unit Month	EPA	Environmental Protection Agency
BA	Basal area	ERU	Ecological response unit
BAER	Burned Area Emergency Response	ESA	Endangered Species Act
BCC	Birds of Conservation Concern	FEIS	Final environmental impact statement
BCR	Bird Conservation Region	FRCC	Fire regime condition class
BE	Biological evaluation	FS	Forest Service
BMP	Best management practice	FSH	Forest Service Handbook
CBM	Condition-based Management	FSM	Forest Service Manual
CCF	Hundred cubic feet	FVS	Forest Vegetation Simulator
CEQ	Council on Environmental Quality	GIS	Geographic information system
CFLR	Collaborative Forest Landscape Restoration	GM	Geophysical Model
CFLRP	Collaborative Forest Landscape Restoration Program	HUC	Hydrologic unit code
CFR	Code of Federal Regulations	IBA	Important bird area
CHU	Critical habitat unit	LANL	Los Alamos National Laboratory
CO	Carbon monoxide	LOPFA	Landscapes outside post-fledging family area
CWD	Coarse woody debris	LMP	Land management plan
DBH	Diameter at breast height	LTIP	Large tree implementation plan
DEIS	Draft environmental impact statement	LTRS	Large tree retention strategy
DF	Design feature	MA	Management area
		MAUM	Thousand animal unit month
		MC	Mixed Conifer
		MIS	Management indicator species

ML	Maintenance level (of a road)	SHG	(4FRI) Stakeholder Group
MRNG	Management Recommendations for the Northern Goshawk in the Southwestern United States	SHPO	State Historic Preservation Office
		SI	Stand improvement
MSO	Mexican spotted owl	SIO	Scenery integrity objectives
NAAQS	National Ambient Air Quality Standards	SWCP	Soil and water conservation practice
		TAP	Travel analysis process
NEPA	National Environmental Policy Act	TCP	Traditional cultural properties
NF	National Forest	TES	Threatened, endangered and sensitive
NFMA	National Forest Management Act		
NHPA	National Historic Preservation Act	TEU	Terrestrial Ecosystem Unit
NMED	New Mexico Environment Department	TMR	Travel Management Rule
		TPA	Trees per acre
NRV	Natural Range of Variation	UEA	Uneven-aged
OHV	Off-highway vehicle	USDA	United States Department of Agriculture
PAC	Mexican spotted owl protected activity center	USDI	United States Department of the Interior
PFA	Northern goshawk post-fledging family area	USFWS	United States Fish and Wildlife Service
PJ	Pinyon-juniper		
PM	Particulate matter	VMS	Visual Management System
PNVT	Potential natural vegetation type	VSS	Vegetation structural stages
P-O	Ponderosa Pine-Oak	WCATT	Watershed Classification and Assessment Tracking Tool
ROS	Recreation opportunity spectrum	WEPP	Water Erosion Prediction Project
ROW	Right-of-way	WFLC	Western Forest Leadership Coalition
RU	Recovery Unit	WUI	Wildland urban interface
SDI	Stand density index		

Summary

The shaded text in this document identifies changes or additions between the DEIS and this FEIS. Deletions are not shown.

Background

The Rim Country Project is a part of the Four Forest Restoration Initiative (4FRI). The 4FRI is a planning effort designed to restore forest resilience and function across four national forests in Arizona: Apache-Sitgreaves, Coconino, Kaibab, and Tonto National Forests (Figure S-1). In 2010, 4FRI was selected to receive Collaborative Forest Landscape Restoration Program (CFLRP) funding; this funding expired in 2019. With restoration being needed at the landscape scale, two large project areas were defined for landscape-scale environmental impact statements (EIS). In 2015, the Record of Decision for the first 4FRI EIS for the northern portion of the Coconino National Forest and the southern portion of Kaibab National Forest was signed. The Rim Country Project is the second landscape-scale EIS.

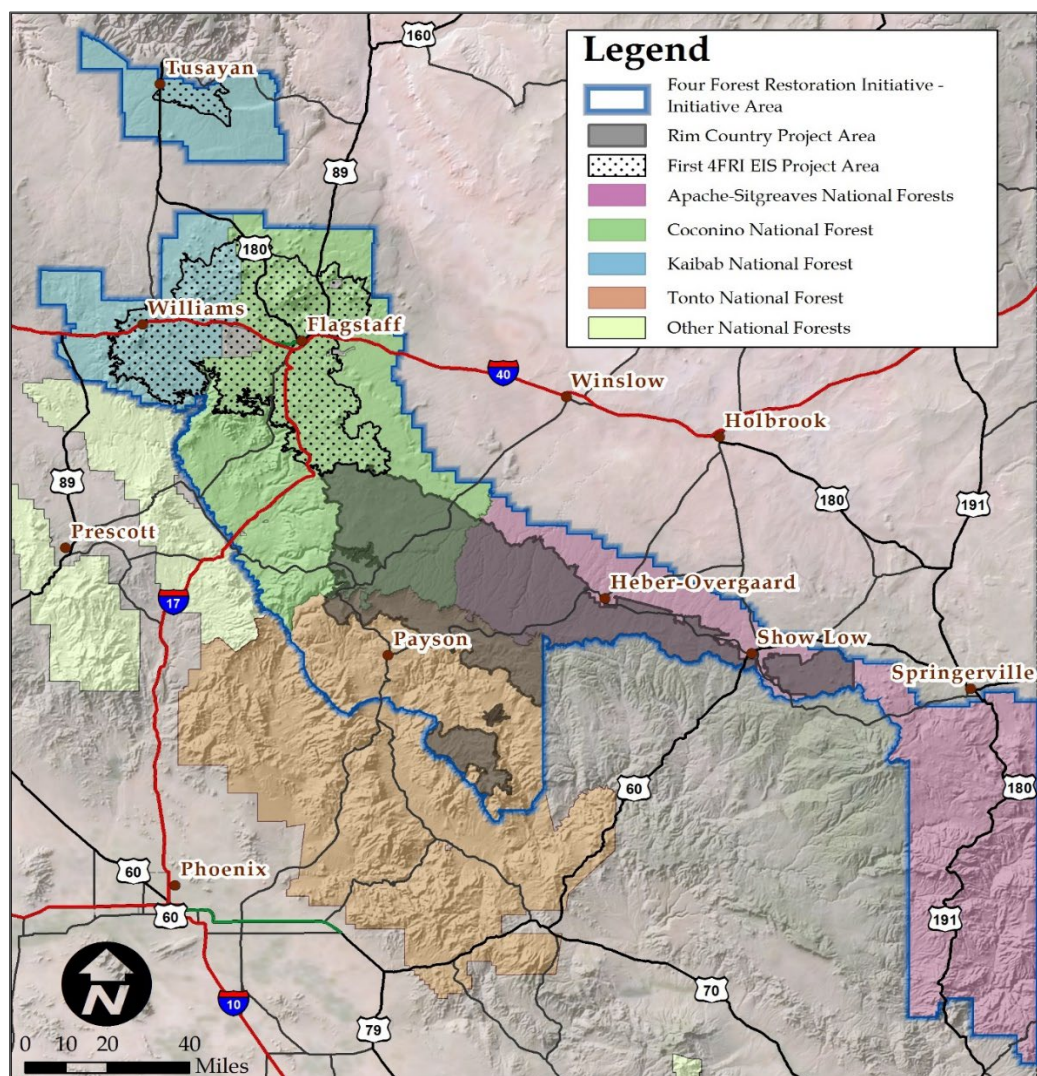


Figure S-1. Four Forest Restoration Initiative

The 4FRI is a result of many years of planning and collaboration among federal, state, and local government agencies and other interested parties, groups, and organizations. The focus has been to restore forest landscapes and reduce the potential for severe **uncharacteristic wildfire** effects in a manner that also benefits the local economy.

The purpose of the 4FRI Rim Country Project is to restore and maintain the structure, pattern, health, function, and composition and diversity in **forests and grasslands** across the landscape, thus moving the project area toward the desired conditions in the respective land management plans. One outcome of restored **forests and grasslands** is increased **ecosystem** resilience. Resilience is the ability of an ecosystem to survive natural disturbances such as fire, insects, disease, and **climate change** without changing its inherent function (FSM 1909.12,05; SER 2004). This project is needed to:

- Increase forest resilience and sustainability,
- Reduce hazard of undesirable fire effects,
- Improve terrestrial and aquatic species habitat,
- Improve the condition and function of streams, springs, and other aquatic and hydrological resources,
- Restore riparian vegetation,
- Preserve cultural resources,
- Support sustainable forest products industries, and
- Improve the motorized transportation system and provide for a more sustainable road system where poorly located roads are relocated or **decommissioned**.

To meet the purpose and need for action, the Apache-Sitgreaves, Coconino, and Tonto National Forests are proposing a suite of restoration activities on approximately **991,060** acres over a period of 20 years or until completed. The area affected by the proposal includes approximately 540,020 acres on the Black Mesa and Lakeside Ranger Districts of the Apache-Sitgreaves National Forests, 398,880 acres on the Mogollon Rim and Red Rock Ranger Districts of the Coconino National Forest, and 299,710 acres on the Payson and Pleasant Valley Ranger Districts of the Tonto National Forest.

The 4FRI Rim Country Project has been published in the Apache-Sitgreaves, Coconino, and Tonto National Forests' Schedule of Proposed Actions since January 2016. The notice of intent to prepare an environmental impact statement was published in the Federal Register on June 27, 2016 (81 FR 41517). A scoping document with the proposed action was sent to parties on the project mailing list (paper copies and electronic mail) and posted on the 4FRI website. Letters were mailed to 676 individuals, local governments, state governments, federal and state agencies, and organizations engaged with the three national forests. Public open houses were held on July 14, 2016, in Show Low, Arizona, and on July 21, 2016, in Payson, Arizona, to discuss the proposed action and accept comments. Fifty scoping responses (e-mails, letters, and public meeting comment forms) were received from this effort.

On October 19, 2019, a notice of availability was published in the Federal Register (ER-FRL-9047-5) for the draft environmental impact statement (DEIS). The notice of availability began a 90-day comment period. The Forest Service received 52 comment letters and emails from Tribal governments, Federal, State, and local agencies, interest groups, businesses, and other members of the public. Comments were received from several government agencies including Coconino County, Arizona Department of Environmental Quality, U.S. Environmental Protection Agency, and Arizona Game and Fish Department which is a cooperating agency for the project. The Forest Service considered all substantive comments and used many to update, make changes, or add clarifications to the FEIS.

Issues

Issues raised during scoping include treatments in Mexican spotted owl protected activity centers, treatments in northern goshawk habitat, large tree retention, dwarf mistletoe mitigation, smoke/air quality, economics, and roads. These issues contributed to alternative and design feature development and focused the analysis in the DEIS. During review and response to comments on the DEIS, dwarf mistletoe mitigation was removed from the analysis. See Chapter 1. Purpose of and Need for Action for information on how these issues, public concerns, and other recommendations were addressed.

Alternatives

Three alternatives were analyzed in detail and four alternatives were considered and eliminated from detailed study. The alternatives analyzed in detail include the no action alternative (alternative 1), the modified proposed action (alternative 2), which is the preferred alternative, and a focused based restoration alternative (alternative 3). Alternatives 2 and 3 respond to the significant issues for the Rim Country Project. See Chapter 2. Alternatives, Including the Proposed Action for detailed information on the alternatives considered and analyzed.

Comparison of Alternatives by Activity

Table S-1. Comparison of alternatives by activity¹

Treatment Type	Proposed Activity	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred)	Alternative 3 Focused Alternative
Mechanical Treatments	Stand improvement	No treatments would occur as a result of this alternative being selected	89,880 acres	46,720 acres
Mechanical Treatments	Uneven-aged thinning	No treatments would occur as a result of this alternative being selected	356,130 acres	210,070 acres
Mechanical Treatments	Aspen restoration	No treatments would occur as a result of this alternative being selected	1,200 acres	980 acres
Mechanical Treatments	Facilitative operations mechanical	No treatments would occur as a result of this alternative being selected	121,610 acres	46,830 acres
Mechanical Treatments	MSO recovery – replacement nest/roost	No treatments would occur as a result of this alternative being selected	23,010 acres	17,950 acres
Mechanical Treatments	MSO PAC – mechanical	No treatments would occur as a result of this alternative being selected	10,990 acres	9,600 acres
Mechanical Treatments	MSO PAC – hand thin	No treatments would occur as a result of this alternative being selected	1,190 acres	590 acres
Mechanical Treatments	Savanna restoration	No treatments would occur as a result of this alternative being selected	18,570 acres	2,470 acres
Mechanical Treatments	Severe disturbance area treatment	No treatments would occur as a result of this alternative being selected	135,490 acres	33,400 acres

Treatment Type	Proposed Activity	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred)	Alternative 3 Focused Alternative
Mechanical Treatments	Wildland-urban interface (WUI) & infrastructure protection	No treatments would occur as a result of this alternative being selected	62,690 acres	45,040 acres
Mechanical Treatments	Grassland restoration ^{1,2} Mechanical subset	No treatments would occur as a result of this alternative being selected	36,290 acres	36,290 acres
Mechanical Treatments	Wet meadow restoration ^{1,3} Mechanical subset	No treatments would occur as a result of this alternative being selected	6,410 acres	6,410 acres
Mechanical Treatments	Riparian restoration ^{1,4} Mechanical subset	No treatments would occur as a result of this alternative being selected	12,790	12,790
Mechanical Treatments	Total mechanical treatment acres	No treatments would occur as a result of this alternative being selected	873,420 acres	466,290 acres
Prescribed Fire Treatments	Prescribed fire along with Mechanical treatment	No treatments would occur as a result of this alternative being selected	873,420 acres	466,290 acres
Prescribed Fire Treatments	Prescribed fire only	No treatments would occur as a result of this alternative being selected	117,640 acres	62,560 acres
Prescribed Fire Treatments	Total prescribed fire treatment acres	No treatments would occur as a result of this alternative being selected	991,060 acres	528,850 acres
Various Comprehensive Restoration Treatments	Springs restored (number)	No treatments would occur as a result of this alternative being selected	184	184
Various Comprehensive Restoration Treatments	Protective barriers around springs, aspen, native willows and bigtooth maples	No treatments would occur as a result of this alternative being selected	200 miles	200 miles
Various Comprehensive Restoration Treatments	General stream restoration (Heavy mechanical stream restoration subset)	No treatments would occur as a result of this alternative being selected	647 miles (402 miles)	647 miles (402 miles)
Various Comprehensive Restoration Treatments	Existing road decommission	No treatments would occur as a result of this alternative being selected	490 miles	490 miles
Various Comprehensive Restoration Treatments	Unauthorized route decommission	No treatments would occur as a result of this alternative being selected	800 miles	800 miles
Various Comprehensive Restoration Treatments	Temporary road construction and decommission	No treatments would occur as a result of this alternative being selected	330 miles	170 miles
Various Comprehensive Restoration Treatments	Road relocation and reconstruction	No treatments would occur as a result of this alternative being selected	As needed	As needed

Treatment Type	Proposed Activity	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred)	Alternative 3 Focused Alternative
Construction and Utilization	In-woods Processing and Storage Sites	0 new sites	12 new sites	12 new sites
Expansion	Rock Pits	No expansion	30% expansion of 11 existing rock pits	30% expansion of 11 existing rock pits

¹ Acres displayed are rounded to the nearest 10 acres and represent the most accurate available estimates based on existing data.

² Overlap exists between the riparian, grassland, and wet meadow restoration categories (approximately 3,120 acres). Includes mechanical and prescribed fire and prescribed fire only treatments.

³ Total grassland restoration using either mechanical and/or prescribed fire treatments is approximately 36,330 acres.

⁴ Total wet meadow restoration using either mechanical and/or prescribed fire treatments is approximately 6,720 acres.

⁵ Total riparian restoration using either mechanical and/or prescribed fire treatments is approximately 14,570 acres.

Design Features, Best Management Practices, and Conservation/Mitigation Measures

Project design features, best management practices and conservation/mitigation measures that minimize or avoid effects from the proposed activities are included in the analysis in this FEIS (see appendix C).

Implementation Plan

An implementation plan (appendix D) was developed in conjunction with the design features found in appendix C. The implementation plan gives guidance for Forest Service personnel to ensure treatments and activities are implemented to meet the purpose and need and land management plan standards and guidelines.

Monitoring and Adaptive Management

Appendix E includes the monitoring and adaptive management plan. This plan details the framework and process for monitoring restoration activities. The 4FRI Stakeholder Group and the Forest Service collaborated on the design of the monitoring and adaptive management plan.

Land Management Plan Consistency

The Rim Country Project was reviewed for consistency with the direction in the Apache-Sitgreaves National Forests Revised Land Management Plan (LMP), as amended (USDA Forest Service 2016), the Coconino National Forest Revised Land Management Plan (USDA Forest Service 2018a), and the Tonto National Forest Land Management Plan, as amended (USDA Forest Service 1985). Consistency evaluations can be found in the project record. The design features (appendix C) and the implementation plan (appendix D) also document how treatment design meets Apache-Sitgreaves, Coconino, and Tonto National Forests plan direction and desired conditions. To better align the 1985 Tonto National Forest LMP standards and guidelines with best available scientific information, a project-specific plan amendment (with three exceptions) is proposed under alternatives 2 and 3 (see appendix B). Substantive analysis requirements as per the 2012 Planning Rule (36 CFR 219.8 and 219.9) are addressed within Chapter 3. Affected Environment and Environmental Consequences.

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Chapter 1. Purpose of and Need for Action

The shaded text in this document identifies changes or additions between the DEIS and this FEIS. Deletions are not shown.

Document Structure

The Forest Service has prepared this FEIS in compliance with the National Environmental Policy Act (NEPA) as amended and other relevant federal and state laws, regulations, and policies. This FEIS discloses the direct, indirect, and cumulative environmental effects that would result from implementation of the modified proposed action (the preferred alternative) and other alternatives presented. The document is organized into three volumes.

Volume 1

Chapter 1. Purpose of and Need for Action: The chapter includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for fulfilling that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.

Chapter 2. Alternatives, including the Proposed Action: This chapter provides a more detailed description of the agency's proposed action as well as an alternative method for achieving the stated purpose. These alternatives were developed and modified based on significant issues raised by the public and other agencies. This discussion also includes design features put in place to ensure consistency with the land management plans for each forest. This chapter also provides a summary table (table 27) of the environmental consequences associated with each alternative.

Chapter 3. Affected Environment and Environmental Consequences: This chapter describes the environmental effects of implementing the alternatives (no action, modified proposed action, and focused restoration alternative). This analysis is organized by resource area and includes water and riparian, soils and watershed, vegetation, fire ecology, noxious and invasive weeds, terrestrial wildlife, aquatics, rare plants, air quality, and climate change – carbon storage.

Volume 1 Index

Volume 2

(Continued) Chapter 3. Affected Environment and Environmental Consequences: This chapter describes the environmental effects of implementing the alternatives (no action, modified proposed action, and focused restoration alternative). This analysis is organized by resource area and includes cultural resources, tribal relations, socio-economics, lands and minerals, range, transportation, recreation, scenery, inventoried roadless areas, land management plan amendment substantive requirements, unavoidable adverse effects, and other required disclosures.

Chapter 4. List of Preparers and Contributors: This chapter provides a list of those who prepared and contributed to the environmental impact statement.

Chapter 5. Distribution List: This chapter lists all tribes, agencies, organizations, and persons to whom the FEIS was provided.

References: This section provides a list of references cited throughout the document to inform the analysis.

Appendices A through D: the appendices provide more detailed information to support the analysis. The appendices included in the FEIS are:

- Appendix A: Maps
- Appendix B: Land Management Plan Amendment for the Tonto National Forest
- Appendix C: Design Features, Best Management Practices (BMPs), Mitigation, and Conservation Measures
- Appendix D: Implementation Plan for Alternatives 2 and 3

Volume 2 Index

Volume 3

Appendices E through I: the appendices provide more detailed information to support the analysis. The appendices included in the FEIS are:

- Appendix E: Monitoring and Adaptive Management Plan
- Appendix F: Mexican Spotted Owl Conservation Recovery Framework
- Appendix G: Glossary
- Appendix H: Response to Comments
- Appendix I: Laws, Regulations, and Policies

Additional documentation, including a more detailed analysis of each resource can be found in the individual specialist reports in the project record. The specialist reports are also available on the 4FRI Rim Country webpage at: www.fs.usda.gov/goto/4FRIRimCountry.

Background

The Four Forest Restoration Initiative (4FRI) is a planning effort designed to restore forest resilience and ecosystem function in forests and associated ecosystems across four national forests in Arizona including the Apache-Sitgreaves, Coconino, Kaibab, and Tonto National Forests (figure 1).

In February 2008, based on recommendations within the statewide strategy, the Analysis of Small Diameter Wood Supply in northern Arizona report (Hampton et al. 2008) was completed. This process demonstrated a level of “social agreement” on how much, where, and under what basic parameters mechanical treatment, as one restoration tool, could be used to accelerate restoration of the 2.4-million-acre initiative area.

To further advance collaborative efforts and secure the necessary assistance, the Forest Service created a task force to work with the Forest Health Council. The purpose of the task force was to identify alternative approaches to accelerating forest restoration in northern Arizona. To move into on-the-ground implementation as quickly as possible, stakeholders consisting of individuals, state and federal agencies, local governments, the four national forests in northern Arizona, and the Forest Service’s Southwestern Regional Office moved forward with 4FRI.

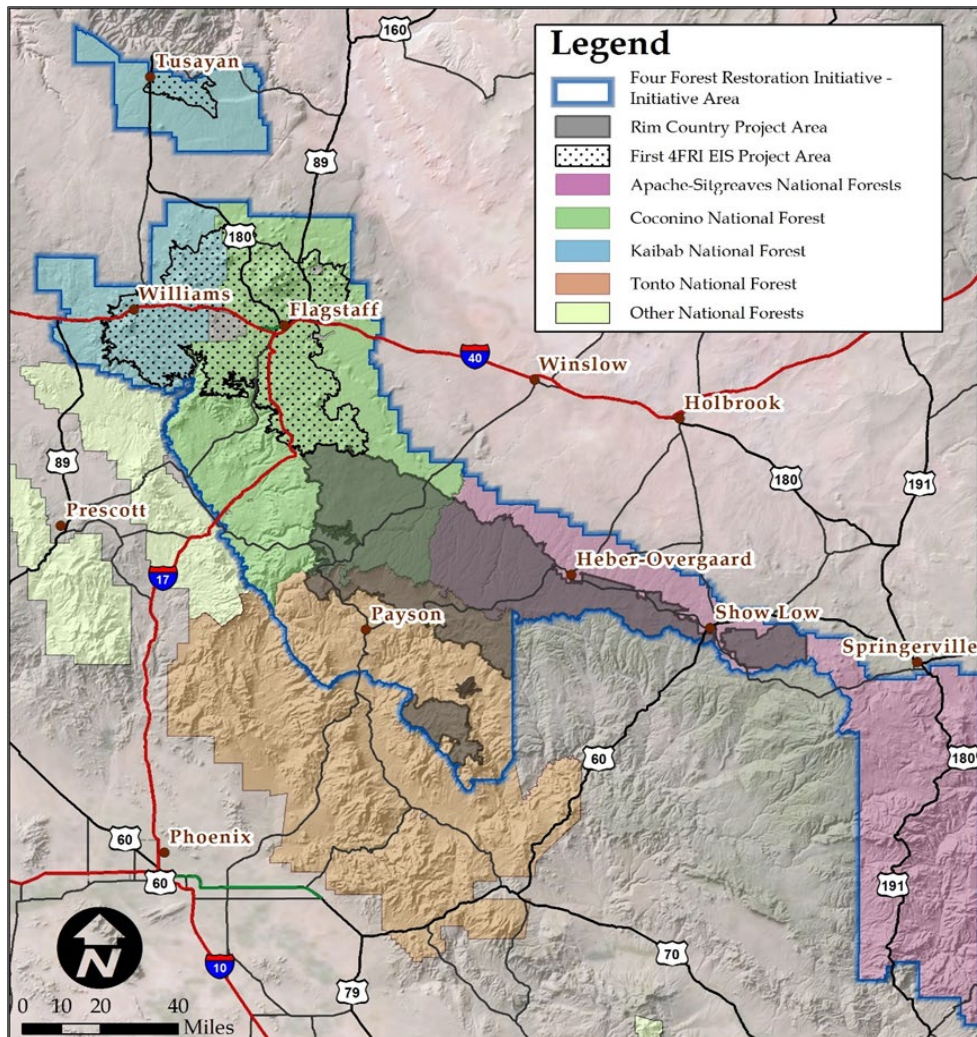


Figure 1. Four Forest Restoration Initiative

Congress created the Collaborative Forest Landscape Restoration Program (CFLRP) in 2009 through the Omnibus Public Land Management Act of 2009 (P.L. 111-11, Title IV Forest Landscape Restoration) to reduce uncharacteristic wildfire and the associated management costs, support local and collaborative partnerships, support monitoring of restoration efforts, and support efforts that utilize forest products that benefit communities and offset treatment costs. In 2010, the 4FRI was competitively selected to receive 10-year funding through 2019. In 2015, the Record of Decision was signed for the first 4FRI EIS for the northern portion of the Coconino National Forest and the southern portion of the Kaibab National Forest.

The Rim Country Project, 2nd 4FRI EIS, continues the ecosystem restoration effort on about 1,240,000 acres on the Black Mesa and Lakeside Ranger Districts of the Apache-Sitgreaves National Forests, the Mogollon Rim and Red Rock Ranger Districts of the Coconino National Forest, and the Payson and Pleasant Valley Ranger Districts of the Tonto National Forest (figure 1). This analysis is independent of any preceding or subsequent environmental analysis that may occur in the national forests across northern Arizona. Title IV, Section 4003(b) of the Omnibus Public Land Management Act identifies eligibility criteria for acceptance into the program. Though 4FRI is no longer receiving funding through the CFLRP, the Rim Country Project purpose and need, alternatives, and continued collaboration efforts still meet the intent of the eligibility criteria.

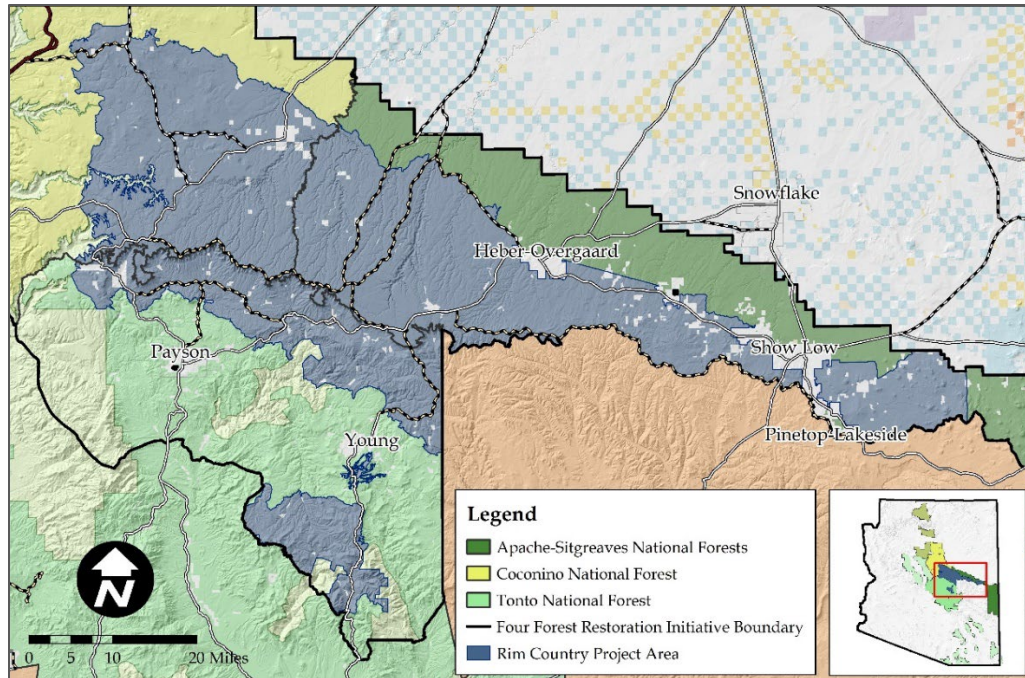


Figure 2. 4FRI Rim Country project area

Current Management Direction

The Rim Country Project was reviewed for consistency with the direction in the Apache-Sitgreaves National Forests Revised Land Management Plan, as amended (USDA Forest Service 2015), the Coconino National Forest Revised Land Management Plan (USDA Forest Service 2018a), and the current Tonto National Forest Land Management Plan, as amended (USDA Forest Service 1985). Consistency evaluations can be found in the project record. Appendix B provides details on the Land Management Plan amendment for the Tonto National Forest proposed in alternatives 2 and 3. The design features in appendix C and the implementation plan in appendix D document how treatment design meets Apache-Sitgreaves, Coconino, and Tonto National Forests Land Management Plan direction. No treatments would occur within wilderness areas; therefore, wilderness is not analyzed.

Wild and Scenic Rivers

There are no designated wild and scenic rivers in the Rim Country project area. Unless otherwise specified, references to wild and scenic rivers in this document refer to either river segments that have been evaluated, have been found to be free-flowing, and, in combination with their adjacent land area, possess one or more outstandingly remarkable values (“eligible rivers”), or river segments that a Federal agency has studied and determined to be suitable for inclusion in the National Wild and Scenic Rivers System but have not been statutorily designated by Congress (“suitable rivers”). A wild and scenic river corridor is the geographic area generally encompassed within one-quarter mile on either side of a river studied for eligibility or suitability that contains the river and its outstandingly remarkable values (FSM 1909.12, 80.5).

Previous eligibility studies identified 12 eligible wild and scenic rivers in the project area. Seven of these occur on the Coconino or Apache-Sitgreaves National Forests or on their shared border (USDA Forest Service 2009, 2013). Five eligible wild and scenic rivers occur on the Tonto National Forest and were identified in a 1993 potentially eligible report covering all the national forests in Arizona (USDA Forest

Service 1993). As part of its ongoing land management plan revision process, the Tonto National Forest is completing a wild and scenic river eligibility study that will replace the 1993 study. For analysis purposes and to be consistent with the land management plan revision, the Rim Country FEIS includes the eligible rivers listed in the most current eligibility study based on comments received from the 2019 Tonto National Forest draft environmental impact statement, which include the draft wild and scenic rivers eligibility study. These segments are not considered eligible until the record of decision is signed for the revised land management plan and associated final environmental impact statement.

Design features have been included in Appendix C specifically for the purpose of adjusting proposed treatments in the future as eligibility and suitability are determined. Any management activities proposed in eligible wild and scenic river corridors in the Rim Country project area would restore natural geomorphic and ecological processes and protecting or enhance the specific outstandingly remarkable values (ORVs) of the river (such as fish and wildlife habitat). In addition, classification of an eligible river must be maintained as inventoried in an eligibility study unless a suitability study is completed that recommends management at a less restrictive classification level, such as from wild to scenic, or scenic to recreational (FSM 1909.12, 84.2).

Inventoried Roadless Areas

The project area contains portions of eight inventoried roadless areas (IRAs) totaling 45,292 acres (figure 3) and timber cutting is proposed to occur in these areas. The 2001 Roadless Area Conservation Rule (36 CFR Part 294, Subpart B) established inventoried roadless areas within the National Forest System. Inventoried roadless areas protect one or more of the nine roadless area characteristics (36 CFR 294.11). Prohibited actions in inventoried roadless areas include road construction/reconstruction and timber cutting. To allow timber cutting in inventoried roadless areas, exception circumstances must exist (36 CFR 294.13(b)) and must maintain or improve one or more of the roadless characteristics ((36 CFR 294.13(b)(1)).

The timber activities proposed within inventoried roadless areas in the project area have been reviewed by the Regional Forester to ensure consistency with implementation of the 2001 Roadless Area Conservation Rule. The Regional Forester has the delegated authority to approve exceptions for prohibited actions within inventoried roadless areas. On November 2, 2021, the Southwestern Region Regional Forester concurred that the activities proposed as part of the Rim Country Project qualify for a Roadless Rule exception under 36 CFR § 294.13 (b)(1)(ii) - Timber, (Ecosystem); and will protect and maintain the nine roadless area characteristics and approved the project to proceed within the inventoried roadless areas under this exception. The Southwestern Regional Forester's concurrence and approval of the exception is documented separately in the Rim Country Regional Forester exception briefing paper that is in the project record.

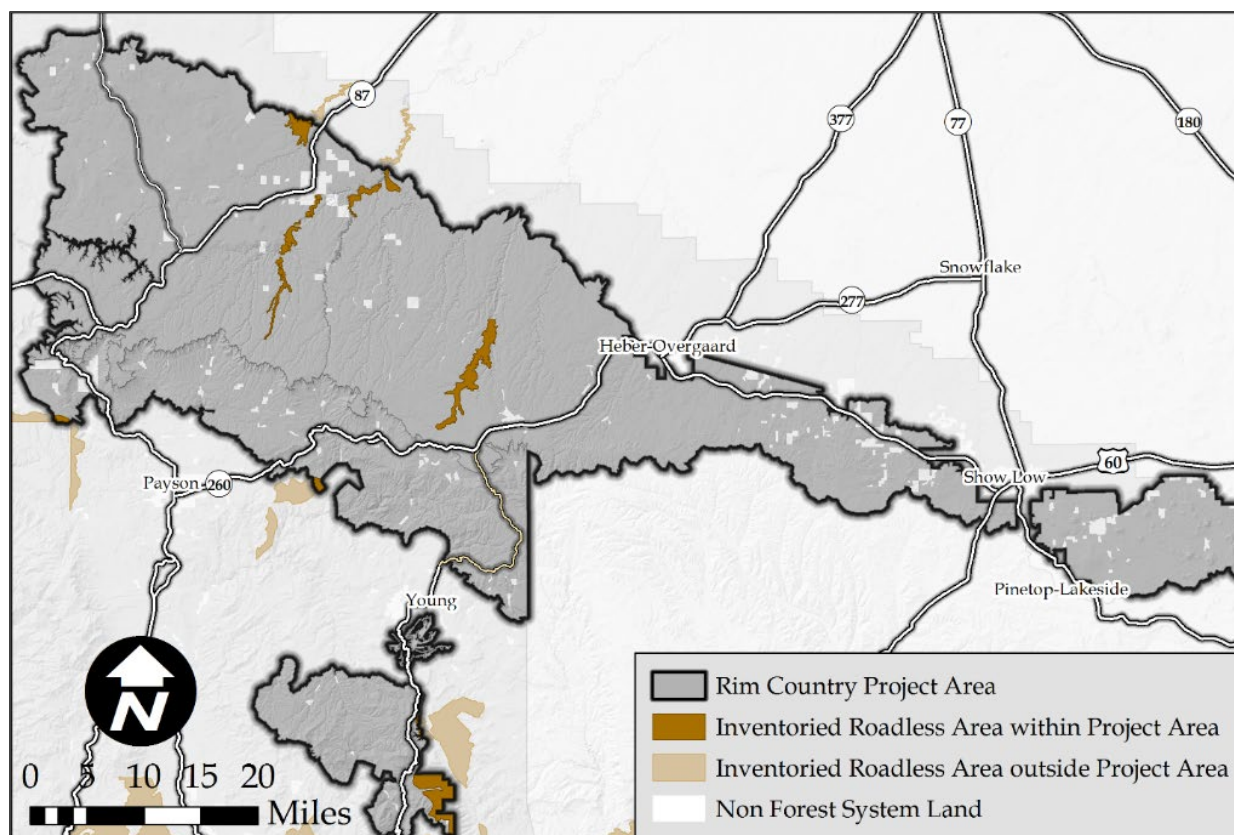


Figure 3. Inventoried roadless areas in the Rim Country project area

Apache-Sitgreaves National Forests

The revised Land Management Plan for the Apache-Sitgreaves National Forests became effective in August 2015. Table 1 describes the Apache-Sitgreaves National Forest management areas located in the Rim Country project area. There are no designated wilderness or recommended wilderness areas in the Rim Country project area.

Table 1. Apache-Sitgreaves Land Management Plan management areas in the Rim Country project area

Forest Management/Designated Area	Description	Land Management Plan Emphasis	Total within Rim Country
Community-Forest Intermix	Lands within ½ mile of communities at risk	Complete initial treatments to reduce fire hazard, maintain with prescribed fire and mechanical treatments	28,480 acres
Energy Corridor	Three existing high-voltage energy corridors	Managed to provide a reliable supply of energy	1,510 acres
General Forest	Majority of the Apache-Sitgreaves National Forests, capable of providing a variety of forest products	Restore priority 6th level HUC watersheds, restore fire-dependent ecosystems, reduce the threat of uncharacteristic wildfire, and provide forest products	431,600 acres
High Use Developed Recreation Area	Places with relatively high levels of visitor use	Recreation site plans to provide a wide variety of opportunities to a broad spectrum of visitors	7,490 acres
Natural Landscape	Undeveloped areas that are natural appearing and provide primitive and semi primitive recreation opportunities	Retain natural appearing character	13,230 acres
Wild Horse Territory	The Heber Wild Horse Territory established in 1973	Manage the territory in accordance with the Wild Horse and Burro Act	18,760 acres
Wildlife Quiet Area	Relatively undisturbed habitat where big game and other wildlife aren't disturbed by motorized vehicle use	Manage for nonmotorized access, improve wildlife habitat, and maintain existing wildlife developments	22,400 acres
General Crook National Recreation Trail	Non-motorized scenic trail	Preserve historic route, features, and associated values	59 miles
Blue Ridge Trail National Recreation Trail	Non-motorized scenic trail	Manage for non-motorized travel and associated values.	9 miles
Desert to Tall Pines Scenic Road	Scenic byway established in 1996.	Blend visual impacts with the overall landscape character.	3 miles
Chevelon Canyon IRA	Inventoried Roadless Area (IRA)	Maintain their overall roadless character.	5,188 acres
Leonard Canyon IRA	Inventoried Roadless Area (IRA)	Maintain their overall roadless character	1,808 acres
Chevelon Creek	Eligible Wild & Scenic River	Protect the existing outstandingly remarkable values, free-flowing condition, and classifications of river corridor	25 miles 7,281 acres within corridor
East Clear Creek	Eligible Wild & Scenic Rivers	Protect the existing outstandingly remarkable values, free-flowing condition, and classifications of river corridor	6 miles 899 acres within corridor
Leonard Canyon	Eligible Wild & Scenic Rivers	Protect the existing outstandingly remarkable values, free-flowing condition, and classifications of river corridor	24 miles 3,164 acres within corridor
Willow Creek	Eligible Wild & Scenic Rivers	Protect the existing outstandingly remarkable values, free-flowing condition, and classifications of river corridor	19 miles 4,861 acres within corridor

Coconino National Forest

The revised Land Management Plan for the Coconino National Forest was signed in March 2018. Table 2 describes the Coconino National Forest management areas located in the Rim Country project area. There are no designated wilderness or recommended wilderness areas in the Rim Country project area.

Table 2. Coconino Land Management Plan management areas in the Rim Country project area

Forest Management/Designated Area	Description	Land Management Plan Emphasis	Total within Rim Country
Anderson Mesa	Grasslands, pinyon juniper, and wetlands on Anderson Mesa	Wildlife-viewing and hunting, supports sustainable population of pronghorn, functioning wetlands	38,020 acres
C.C. Cragin Watersheds	Watersheds for C.C. Cragin Reservoir along the Mogollon Rim	Coordinate with partners to proactively improve the health and resilience of the watersheds, reduce the threat of uncharacteristic wildfires, flooding, and sedimentation, and maintain water quality and quantity	46,000 acres
Long Valley	Ponderosa pine, grassland, riparian, pinyon juniper, mixed conifer, and wetlands in the Long Valley area	Functioning wetlands, low-disturbance wildlife habitat, a mix of dispersed and developed recreation opportunities	156,020 acres
Pine Belt	Dominant ponderosa pine vegetation belt	Functioning wetlands, backcountry recreation, wildlife viewing and hunting	102,230 acres
East Clear Creek	Remote area of East Clear Creek and its tributaries along the Mogollon Rim	Low disturbance wildlife habitat, primitive and semi primitive recreational opportunities	54,960 acres
Verde Valley	The Verde Valley north and west of the Verde River	Reduced risk of uncharacteristic flooding and sedimentation, recreational opportunities, interconnected trail system	1,640 acres
Mogollon Rim Botanical Area	Preserves unique white fir/bigtooth maple community	Interpretation and monitoring	340 acres
Long Valley Experimental Forest	Experimental Forest	Managed by the Rocky Mountain Research Station	1,260 acres
Rocky Gulch Research Natural Area (proposed)	Area of old-growth ponderosa pine used as a control for research in the Beaver Creek watershed	Prepare establishment report	930 acres
Arizona National Scenic Trail	Nationally designated non-motorized scenic trail	Minimize visual impacts, keep well maintained, signed, and passable	43 miles
General Crook National Recreation Trail	Nationally designated non-motorized scenic trail	Preserve historic route, features, and associated values	37 miles
Barbershop Canyon IRA	Inventoried Roadless Area (IRA)	Maintain the overall roadless character of inventoried roadless areas.	1,310 acres
East Clear Creek IRA	Inventoried Roadless Area (IRA)	Maintain the overall roadless character of inventoried roadless areas.	1,612 acres

Forest Management/Designated Area	Description	Land Management Plan Emphasis	Total within Rim Country
Jacks Canyon IRA	Inventoried Roadless Area (IRA)	Maintain the overall roadless character of inventoried roadless areas.	1,717 acres
Barbershop Canyon	Eligible Wild & Scenic Rivers	Protect the existing outstandingly remarkable values, free-flowing condition, and classifications of river corridor	14 miles 3,741 acres within corridor
East Clear Creek	Eligible Wild & Scenic Rivers	Protect the existing outstandingly remarkable values, free-flowing condition, and classifications of river corridor	23 miles 5,118 acres within corridor
Leonard Canyon	Eligible Wild & Scenic Rivers	Protect the existing outstandingly remarkable values, free-flowing condition, and classifications of river corridor	24 miles 3,069 acres within corridor
West Clear Creek	Eligible Wild & Scenic Rivers	Protect the existing outstandingly remarkable values, free-flowing condition, and classifications of river corridor	0 miles 1,745 acres within corridor
Wet Beaver Creek	Eligible Wild & Scenic Rivers	Protect the existing outstandingly remarkable values, free-flowing condition, and classifications of river corridor	0 miles 19 acres within corridor

Tonto National Forest

The Tonto National Forest Land Management Plan is presently being revised. The current plan was developed under the 1982 Planning Rule and went into effect in 1985. Activities proposed in alternatives 2 and 3 are based on the best available scientific information, which includes more than 36 years of advances in forest management science and learning since the current Land Management Plan was developed. Table 3 describes the current Tonto National Forest management areas located in the Rim Country project area. Table 4 describes the Tonto National Forest draft land management plan management areas located in the Rim Country project area. There are no designated wilderness areas or recommended wilderness areas in the Rim Country project area.

Table 3. Tonto 1985 Land Management Plan management areas and designations in the Rim Country project area

Forest Management/Designated Area	Description	Land Management Plan Emphasis	Total within Rim Country
4D: Mogollon Rim Area	Ponderosa pine forest below the Mogollon Rim, Payson Ranger District	Intensive sustained yield timber management, timber resource protection, wildlife habitat diversity, recreation opportunity	133,010 acres
4F: General Management Area	General management area on the Payson Ranger District	Wildlife habitat improvement, livestock forage production, dispersed recreation	15,570 acres
5D: Mogollon Rim-Sierra Ancha Area	Ponderosa pine forest below the Mogollon Rim and in the Sierra Ancha Mountains, Pleasant Valley Ranger District	Intensive sustained yield timber management, timber resource protection, wildlife habitat diversity, recreation opportunity	121,580 acres
5G: General Management Area	General management area on the Pleasant Valley Ranger District	Wildlife habitat improvement, livestock forage production, dispersed recreation	29,480 acres

Forest Management/Designated Area	Description	Land Management Plan Emphasis	Total within Rim Country
Sierra Ancha Experimental Forest	Experimental forest in the Pleasant Valley Ranger District.	The Experimental Forest was established and is managed for purposes of research on vegetative treatments for increasing water yield. The Experimental Forest is operated by the Rocky Mountain Research Station, Flagstaff, Arizona, often cooperatively with Arizona State University and the University of Arizona	47 acres
Highline National Recreation Trail	Nationally designated recreation trail	Preserve historic route, features, and associated values	44 miles
Hellsgate IRA	Inventoried Roadless Area (IRA)	Maintain the overall roadless character of inventoried roadless areas.	338 acres
Mazatzal IRA	Inventoried Roadless Area (IRA)	Maintain the overall roadless character of inventoried roadless areas.	316 acres
Sierra Ancha Wilderness Contiguous IRA	Inventoried Roadless Area (IRA)	Maintain the overall roadless character of inventoried roadless areas.	4,613 acres

Table 4. Tonto National Forest draft Land Management Plan management areas in the Rim Country project area

Forest Management/Designated Area	Description	Land Management Plan Emphasis	Total within Rim Country
Little Green Valley Fen (Recommended) Botanical Area	Recommended Botanical Area	Maintain rare and sensitive wetland meadow with peat soils and provide opportunities for education and research.	13 acres
Arizona National Scenic Trail	Nationally designated non-motorized scenic trail	Minimize visual impacts, keep well maintained, signed, and passable	27 miles
Highline National Recreation Trail	Nationally designated recreation trail	Preserve historic route, features, and associated values	44 miles
Hellsgate IRA	Inventoried Roadless Area (IRA)	Maintain the overall roadless character of inventoried roadless areas.	338 acres
Mazatzal IRA	Inventoried Roadless Area (IRA)	Maintain the overall roadless character of inventoried roadless areas.	316 acres
Sierra Ancha Wilderness Contiguous IRA	Inventoried Roadless Area (IRA)	Maintain the overall roadless character of inventoried roadless areas.	4,613 acres
Canyon Creek	Eligible Wild & Scenic Rivers	Protect the existing outstandingly remarkable values, free-flowing condition, and classifications of river corridor	7 miles 1,914 acres within corridor
Christopher Creek	Eligible Wild & Scenic Rivers	Protect the existing outstandingly remarkable values, free-flowing condition, and classifications of river corridor	2 miles 890 acres within corridor
Pueblo Canyon	Eligible Wild & Scenic Rivers	Protect the existing outstandingly remarkable values, free-flowing condition, and classifications of river corridor	0 miles 9 acres within corridor

Forest Management/Designated Area	Description	Land Management Plan Emphasis	Total within Rim Country
Tonto Creek (Upper)	Eligible Wild & Scenic Rivers	Protect the existing outstandingly remarkable values, free-flowing condition, and classifications of river corridor	0.1 miles 208 acres within corridor
Workman Creek	Eligible Wild & Scenic Rivers	Protect the existing outstandingly remarkable values, free-flowing condition, and classifications of river corridor	0.1 miles 82 acres within corridor

To align the Tonto National Forest 1985 LMP standards and guidelines with best available scientific information, a project-specific plan amendment, with three exceptions, is proposed (see chapter 3 and appendix B). Substantive analysis requirements as per the 2012 Planning Rule as amended (36 CFR 219.8 and 219.9) are addressed and integrated into the analysis of the alternatives presented in Chapter 3. This project-specific plan amendment under alternatives 2 and 3 is a one-time variance in the current Tonto National Forest land management plan direction specifically for the Rim Country Project. Appendix B contains the specific standards and guidelines that would be amended and the amendment language. Alternatives 2 and 3 would be consistent with the desired conditions, objectives, standards, and guidelines revised Tonto Land Management Plan once in effect.

The amendment would be required under the current Tonto National Land Management Plan if the Rim Country Record of Decision is signed prior to the revised Tonto National Land Management Plan going into effect (anticipated in 2022). If this is the case, the Record of Decision would include: a decision on which alternative to implement and a decision on which Land Management Plan amendment components to approve. However, if the revised Tonto National Land Management Plan goes into effect before the Rim Country Record of Decision is signed, the proposed project-specific amendment would no longer be necessary. This is because each alternative outlined in the Tonto National Forest DEIS (USDA FS 2019b), released in December 2019, would not need an amendment for the project to move forward. The Rim Country Project was reviewed for consistency with the Draft Tonto National Forest Land Management Plan (USDA FS 2019).

Existing and Desired Conditions

The following description of existing and desired conditions is a summary. Full descriptions of existing conditions in the Rim Country project area can be found in chapter 3 of this FEIS by resource area as well as the associated specialist reports. Desired conditions for the Rim Country project area are incorporated by reference from the current Apache-Sitgreaves, Coconino, and Tonto National Land Management Plans.

Existing Conditions

The forested landscapes in the Rim Country project area are highly departed from desired conditions, lacking desired species composition, spatial arrangement, and structure. Stands across the majority of the area where thinning treatments are proposed exhibit extremely high densities as measured by basal area, trees per acre, stand density index (SDI). Some of these areas are at high risk for disturbance from uncharacteristic fire behavior, insects and disease, density-related mortality, and climate change.

Table 5 shows the cover types that occur on National Forest System lands within the Rim Country project area (including areas that are parts of ongoing projects or other analyses). Table 6 shows the cover types that occur on National Forest System lands within the wildland urban interface (WUI) and the critical infrastructure buffer and figure 4 displays this same information. Table 7 compares the existing conditions to the desired conditions in areas proposed for mechanical thinning and prescribed fire.

Table 5. Acres of cover type on forest service-managed land within the project area

Cover Type	Total Acres
Aspen	1,422
Grassland/Meadow*	20,393
Madrean Encinal Woodland	1,689
Madrean Pinyon-Oak	23,056
Mixed Conifer with Aspen	19,848
Mixed Conifer/Frequent Fire*	59,859
Pinyon-Juniper Woodland	143,311
Ponderosa Pine*	765,138
Ponderosa Pine/Evergreen Oak*	149,440
Riparian	14,571
Other - Dam/Pit/Road/Water	3,013

*Target cover type: frequent-fire type targeted for restoration treatments

Table 6. Acres of cover type on forest service managed land within wildland urban interface and critical infrastructure buffer

Forest Type	Acres
Ponderosa Pine	140,675
Ponderosa Pine/Evergreen Oak	34,921
Mixed Conifer/Frequent Fire	5,965
Mixed Conifer with Aspen	2,306
Aspen	192
Pinyon-Juniper Woodland	33,315
Madrean Encinal Woodland	844
Madrean Pinyon-Oak	4,242
Grassland/Meadow	5,105
Riparian	4,392
Other	1,412
Grand Total	233,369

Table 7. Desired conditions compared to existing conditions in areas proposed for mechanical thinning

	Desired Condition	Existing Condition
Structure - Pattern	The majority of stands are in an open condition. Forest arrangement is in individual trees, small clumps, and groups of trees or randomly spaced trees interspersed within variably sized openings of grasses, forbs, and shrubs that are similar to historic patterns. Most forest stands in uneven-aged condition to meet forest resilience and sustainability goals while maintaining wildlife habitat.	The majority of stands are in a closed condition and lacking groups and clumps of trees or randomly spaced trees. Grasses, forbs and shrubs are underrepresented compared to historic patterns. This is departed from desired conditions consisting of a matrix of groups, clumps and individual randomly spaced trees with interspaces or openings.
Structure - Trees per acre	Trees are distributed across size classes with total number of trees per acre between 10 and 250. An idealized tree distribution across size classes totaling 74 trees per acre and carrying 90 square feet per acre of basal area would have 24, 18, 14, 10, and 8 trees in the 0-5", 5-12", 12-18", 18-24" and 24"+ size classes, respectively.	Total trees per acre is higher than the desired condition and are overrepresented in the smaller diameter classes and underrepresented in the larger classes. There are currently 718, 103, 32, 8, and 3 trees in the 0-5", 5-12", 12-18", 18-24" and 24"+ DBH size classes, respectively.
Basal Area	Generally less than 90 square feet per acre to meet forest resilience goals, while maintaining wildlife habitat desired conditions. For MSO protected and nest/roost replacement habitat 110 to 120 square feet per acre is the minimum.	The current average basal area within the project area is 115 square feet per acre. High densities in terms of basal area make trees more susceptible to mortality from insects, disease, and competition and increase crown fire risk.
Stand Density Index	Maintain forest density between 25 percent and 45 percent of SDImax to maintain forest health and tree growth. For ponderosa pine this SDI range is between 112.5 and 202.5. For MSO protected and Nest/Roost replacement habitat in ponderosa pine, desired forest density is between 45 percent and 60 percent of SDImax or between 202.5 and 270.	Currently 18 percent of stands meet the desired condition for SDI. High densities in terms of stand density index make trees more susceptible to mortality from insects, disease, and competition and increase crown fire risk.
Forest Insects	Stands in the project area are in the low or moderate hazard for bark beetles.	Currently 69 percent of acreage have a high bark beetle hazard rating. The remaining 31 percent of stands meet the desired condition for insect hazard.
Forest Disease	Stands in the project area have low to moderate dwarf mistletoe infection severity (Less than 20 percent of trees infected).	Currently 71 percent of acreage has a low dwarf mistletoe infection rating. 26 percent of acres have a moderate rating and 4 percent have a severe infection rating. 96 percent of the project area meets the desired condition for mistletoe infection severity.

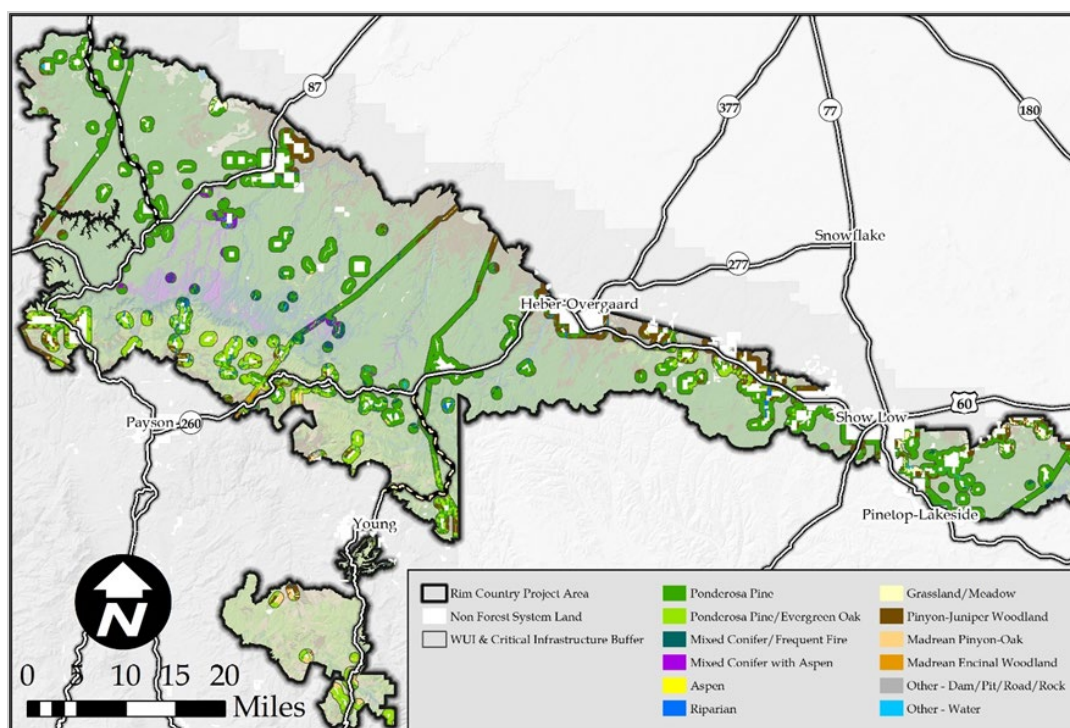


Figure 4. Map of forest types within wildland urban interface and critical infrastructure buffer

Across the project area, fire regimes constitute a spatial and temporal mosaic of landscape patterns. There is a need to reintroduce or maintain fire in ponderosa pine, aspen, mixed conifer, and grasslands in the project area. Currently, across much of the project area, fuel loading in the immediate vicinity of many large and/or old trees is such that mortality would be high in the event of a wildfire burning under undesirable conditions. With a delay of 10 to 20 years between fires or mechanical treatments, areas currently showing potential for passive crown fire are likely to transition to active crown fire, depending on geographic location and site conditions. Table 8 shows the existing crown fire potential in ponderosa pine cover types.

Table 8. Existing crown fire potential in ponderosa pine cover types

Vegetation Cover Type	All Crown Fire	Active Crown Fire
Ponderosa Pine	72%	20%
Ponderosa Pine/Evergreen Oak	82%	29%

Currently, modeling results show that, under conditions similar to those of the Rodeo-Chediski Fire, there is potential for approximately 75 percent of the mixed conifer in the Rim Country project area to burn with crown fire, of which 50 percent would be active crown fire, as shown in table 9.

Table 9. Existing crown fire potential in dry mixed conifer cover type

Vegetation Cover Type	All Crown Fire	Active Crown Fire
Mixed Conifer- Frequent Fire	75%	50%

The exclusion of fire has resulted in high canopy cover and high tree density which limits the amount of sunlight and precipitation reaching the ground. Consequently, understory vegetation is less diverse, sparse, and provides poorer quality food and cover for wildlife than under more open canopies.

The ponderosa pine and mixed conifer cover types support a wide range of wildlife species, including the Mexican spotted owl, species listed as threatened under the Endangered Species Act. The Rim Country project area includes approximately 120,522 acres of Mexican spotted owl protected activity centers and approximately 219,657 acres of recovery habitat. Protected activity centers currently contain high fuel loadings due to management actions for the last few decades. There are also 55,608 acres of northern goshawk post-fledgling areas, with an additional 938,680 acres of foraging habitat. The increased tree densities, closed canopies, and loss of habitat heterogeneity have led to the loss of habitat for a wide range of species, including ground and shrub-nesting passerines and small mammals and birds that depend upon the herbaceous understory for food and/or cover. Current stand conditions exhibit declining to stagnant tree growth in areas where late-successional habitat is desired.

Aspen are dying or rapidly declining in the Rim Country project area due to the combined effects of conifer encroachment, browsing, grazing, insects, disease, severe weather events, and lack of fire disturbance.

There are approximately 146,460 acres (severe disturbance areas) where high-severity effects from fires, such as the Dude and Rodeo-Chediski fires, and insect and disease outbreaks have resulted in reduced forest cover and a departure from desired conditions.

Southwestern dwarf mistletoe is a natural component of the forests in the Rim Country project area. Dwarf mistletoe can create or increase forest openings at endemic levels (Conklin 2000), improving wildlife habitat (Parker 2001) by creating unique canopy structure and snags with longevity and conditions that stimulate understory growth (Conklin 2000). At epidemic levels, mistletoe can prevent stands from attaining mature and old-growth conditions (Conklin and Fairweather 2010), preventing trees from attaining nest and roost structure for species like the Mexican spotted owl and northern goshawk. Infections of high severity can increase tree stress, the likelihood of bark beetle infestations during periods of drought, and tree death (Kenaley 2008).

While the overall incidence (distribution and percent of landscape affected) of dwarf mistletoe is thought to have increased only modestly compared to historic conditions, the overall abundance of mistletoe is thought to have increased considerably (Conklin and Fairweather 2010). Stands covering approximately 22 percent of the Rim Country project area exhibit infections at moderate severity levels (20 percent to 80 percent of susceptible trees infected) while stands making up four percent of the area have high-severity infection ratings (more than 80 percent of susceptible trees infected) (USDA Forest Service 2022).

Grasslands, savannas, and meadows provide valuable habitat for many wildlife species including pronghorn antelope (a focal species), raptors such as western burrowing owls, Swainson's hawks, and ferruginous hawks (sensitive species/migratory birds), an abundance of small mammals including Navajo Mogollon voles (sensitive species), and a range of important prey species for both MSOs and northern goshawks. Savannas and meadows are also used by game species such as elk and black bears. In the meadows and grasslands of the Rim Country project area, junipers and other conifers have encroached into these once open grassland habitats, decreasing the size and function of landscapes that were historically grasslands. As tree canopy increases, understory productivity decreases. The grasslands have impaired soil conditions due to inadequate protective ground cover, compacted soil surfaces, and encroaching pines and junipers. In many meadows, vegetative ground cover is low, hydrologic soil

function is reduced from compaction, groundwater levels have dropped below root zones due to gully formation and encroaching upland tree species are competing with desired species.

The Coconino National Forest established its Travel Management Rule (TMR) motor vehicle use designations in 2011; the Tonto National Forest published its final Record of Decision for TMR designations in 2021; and the Apache-Sitgreaves National Forests is expected to release the Draft Record of Decision for TMR designations in 2022.

Most watersheds in the Rim Country project area have been assigned a fair or poor rating for road and trail density, location, distribution, and maintenance. Roads near streams have the greatest effects on water quality. High road density increases effective drainage density, which can increase the size of damaging peak flows.

There are approximately 360 known springs in the Rim Country project area. A limited number have been assessed, but these assessments indicate that many springs in the project area have been adversely affected by human activities such as flow regulation through installation of spring boxes and piping of discharge to off-site locations, recreation, and urbanization and other construction activities, as well as grazing by wild and domestic herbivores. Approximately 184 springs in the Rim Country project area exhibit declining or degraded conditions where restoration treatments may be applied.

Many riparian streams in the Rim Country project area, particularly within the Rodeo-Chediski Fire area, are currently non-functioning¹ or functioning-at-risk², with accelerated erosion and increased peak flows. Table 10 shows the condition classes of riparian areas by national forest within the project area.

Table 10. Condition classes of riparian streams in the project area by national forest

Forest	Total (miles*)	Properly Functioning (miles*)	Functioning- at-Risk (miles*)	Non-Functioning (miles*)
Apache-Sitgreaves	240	60	113	67
Coconino	196	120	53	23
Tonto	440	77	309	54
Totals	876	257	475	144

*Miles are approximate

The Rim Country project area provides habitat for three federally listed and 12 Forest Service sensitive terrestrial species (table 11, table 12). Within the Rim Country project area there are approximately 360 miles of streams that are occupied by, or are suitable for, aquatic species such as fish, gartersnakes, mollusks, and invertebrates. These streams and associated 6th Hydrologic Unit Code (HUC) watersheds provide habitat for 8 federally listed fish and gartersnake species and 17 Forest Service Southwestern Region sensitive species, one of which are also federally listed (see table 11, table 12, table 13). There are 11 Forest Service Southwestern Region sensitive plant species (table 12). Bebb's willow provides habitat for songbirds and small mammals, as well as soil and stream bank stability and is declining in health, vigor, and number in the project area.

¹ These riparian areas clearly are not providing adequate vegetation, landform, or woody material to dissipate stream energy associated with moderately high flows, and thus are not reducing erosion or improving water quality.

² These riparian areas are in limited functioning condition: however, existing hydrologic, vegetative, or geomorphic attributes make them susceptible to impairment.

Table 11. Status for federally listed species analyzed

Species	Status
Mexican wolf	Endangered
Mexican spotted owl	Threatened with Critical Habitat
Western yellow-billed cuckoo	Threatened with Critical Habitat
Gila trout	Threatened
Gila chub	Endangered with Critical Habitat
Gila topminnow**	Endangered
Little Colorado spinedace	Threatened with Critical Habitat
Loach minnow	Endangered with Critical Habitat
Spikedace	Endangered with Critical Habitat
Narrow-headed gartersnake*	Threatened and Sensitive with proposed Critical Habitat
Chiricahua leopard frog	Threatened with Critical Habitat

* USFWS considered all proposed critical habitat as occupied for these species in the Federal Register proposed ruling. These are also Forest Service Southwestern Region sensitive species.

** Species not known to occur within the project area, but does occur within a watershed in the action area.

Table 12. Status for sensitive species analyzed

Species	Status
Lowland leopard frog	Sensitive
Bald eagle	Sensitive
Golden eagle	Sensitive
Northern goshawk	Sensitive
American peregrine falcon	Sensitive
Burrowing owl (western)	Sensitive
Navajo Mogollon vole	Sensitive
Western red bat	Sensitive
Spotted bat	Sensitive
Allen's lappet-browed bat	Sensitive
Pale Townsend's big-eared bat	Sensitive
desert sucker	Sensitive
Sonoran sucker	Sensitive
Little Colorado sucker	Sensitive
headwater chub	Sensitive
roundtail chub	Sensitive
northern leopard frog	Sensitive
A net-winged midge	Sensitive
A stonefly	Sensitive
Parker's cylloepus riffle beetle	Sensitive
A mayfly (<i>Fallceon eatoni</i>)	Sensitive
A mayfly (<i>Moribaetis mimbresaurus</i>)	Sensitive
A caddisfly (<i>Lepidostoma apache</i>)	Sensitive
A caddisfly (<i>Lepidostoma knalli</i>)	Sensitive
A caddisfly (<i>Limnephilus granti</i>)	Sensitive
Ferris' copper butterfly	Sensitive
Nokomis fritillary	Sensitive

Species	Status
California floater	Sensitive
Villous groundcover milkvetch	Sensitive
Arizona bugbane	Sensitive
Dane thistle	Sensitive
Hairy clematis (Arizona leatherflower)	Sensitive
Mogollon fleabane	Sensitive
Rock fleabane	Sensitive
Arizona sneezeweed	Sensitive
Eastwood (Senator Mine) alumroot	Sensitive
Flagstaff beardtongue	Sensitive
Blumer's dock	Sensitive
Bebb's willow	Sensitive

Table 13. Status for management indicator species analyzed

Common Name	Status
Aquatic macroinvertebrates	Management Indicator Species
Terrestrial wildlife species	Management Indicator Species

Desired Conditions

The proposed treatments in the Rim Country Project would restore or move the project area toward desired conditions as described in the Apache-Sitgreaves, Coconino, and Tonto National Land Management Plans, and help to re-establish resilient and functioning ecosystems. The proposed mechanical treatments (thinning) are specifically designed to establish interspaces or openings, reflecting pre-fire suppression-spatial patterns and uneven-aged stand structure, and improve stand structure and health. Table 7 displays the desired conditions related to stand structure, pattern, density, and health.

Desired conditions are for no more than 15 percent of the ponderosa pine (under conditions modeled) in the treatment area to be prone to crown fire or high-severity fire, with areas of potential high severity spatially distributed. For the dry mixed conifer cover type, land management plan direction is to allow fire to play its natural role, with high frequency (averaging about 12 years) and mostly low severity (less than 20 percent high severity under modeled conditions). Implementing prescribed fire and mechanical treatments would decrease surface and canopy fuel loading, as well as ladder fuels in the immediate vicinity of old trees. This would decrease potential fire-caused mortality in large and/or old trees. Use of prescribed burning, particularly when combined with mechanical thinning, would reduce the potential for damage from wildfires, the costs associated with fire suppression and safety concerns for fire managers.

Desired conditions for Mexican spotted owl and northern goshawk habitat include large tree size-classes and higher tree densities for nest areas, activity centers, surrounding nest core areas, and habitat for general foraging and movements. There is a need to restore resilient late-successional forest and increase habitat diversity, particularly within Mexican spotted owl protected activity centers. Improving stands of larger/older trees would improve nesting habitat. Moving toward a forest structure with all age and size classes represented would improve Mexican spotted owl recovery habitat and overall habitat for northern goshawks. Creating rooting zones and returning low-severity fire would maintain a mosaic of grass, forbs, and shrubs, benefiting key prey species for both owls and goshawks.

Grasslands were designated a priority habitat in the Arizona Partners in Flight Bird Conservation Plan, with the objective to permanently protect, enhance, and/or restore over 500,000 acres of grassland in

northern Arizona. Grasslands and meadows should have satisfactory soil conditions, with vegetative cover adequate to prevent erosion above tolerance conditions, uncompacted soil surfaces that allow for satisfactory hydrologic function and desirable vegetation, and little to no tree encroachment.

As TMR plans are completed and implemented for each forest, poorly located roads may be improved, removed, or relocated to reduce effects on water quality and natural resources. The Forest Service would reclaim any previously disturbed areas used as temporary access roads on National Forest System lands once activities specified in the decision for the Rim Country Project are completed.

Springs exhibiting degraded or declining condition and function need to be improved to sustain these important ecological features. Spring restoration would include reducing tree encroachment and invasive species and noxious weeds, returning fire to the system (through prescribed fire), placing protective barriers, restoring flow to historic areas of influence, restoring or repairing damaged infrastructure, and removing dilapidated or non-functioning infrastructure where appropriate.

Desired conditions for riparian zones along streams are that they are capable of filtering sediment, capturing and/or transporting bedload (aiding floodplain development, improving flood-water retention, improving or maintaining water quality), and providing ground water recharge within their natural potential. Their necessary physical and biological components provide habitat for a diverse community of plant and wildlife species including cover, forage, available water, microclimate, and nesting/breeding/transport habitat. Stream habitats and aquatic species depend upon perennial streams or reaches, and their habitat is maintained by the watershed, soil, and riparian conditions within the ecosystem.

Desired conditions for streams and aquatic habitats are to support native fish and other aquatic species, providing the quantity and quality of aquatic habitat within the natural range of variation. This includes increasing habitat complexity such as pools and large woody debris, reducing downcutting and sedimentation, improving riparian areas that provide channel stability and leaf litter, and stream shading to maintain water temperatures.

The habitat for rare plant species will remain suitable and capable to support them. Any negative effects on these species from management actions will be mitigated and that the goal is for plant numbers to remain the same or increase. To stimulate growth, recruit younger age classes, and increase individual recruitment of aspen, protective barriers would be placed around sites to prevent browsing and other disturbance during regeneration. Protective barriers would also be placed around pockets of Bebb's willow and bigtooth maple to reduce browsing and other disturbances, recruit younger age classes, increase populations, and retain this diverse habitat until they are sustainable.

Purpose and Need for Action

The purpose and need for the Rim Country Project was determined by comparing the existing conditions to the desired conditions in the land management plans related to forest and ecosystem function and resilience. In addition, relevant research, best available science and information, and the landscape restoration criteria found in the Omnibus Public Land Management Act of 2009 (P.L. 111-11, Title IV Forest Landscape Restoration) were used to develop the purpose and need. Among other things, these criteria require that landscape-scale restoration strategies maintain or contribute to the restoration of the structure and composition of old growth stands, maximize the retention of large trees to the extent that they promote fire-resilient stands, focus on small-diameter tree thinning, do not require the establishment of permanent roads, and commit to decommission all temporary roads built for treatment purposes. The 4FRI was a Collaborative Forest Landscape Restoration Project. Though 4FRI is no longer receiving

funding through the CFLRP, the Rim Country Project purpose and need still meets the intent of the eligibility criteria and the project will continue to meet the principles of the program. Below is some of the pertinent language from the Omnibus Public Land Management Act as it relates to the Rim Country Project:

Omnibus Public Land Management Act of 2009, Pub. L. No. 111-11, Title IV, Sec. 4003:

(b) Eligibility Criteria- To be eligible for nomination under subsection (c), a collaborative forest landscape restoration proposal shall—

(1) be based on a landscape restoration strategy that—

(A) is complete or substantially complete;

(B) identifies and prioritizes ecological restoration treatments for a 10-year period within a landscape that is—

(i) at least 50,000 acres;

(ii) comprised primarily of forested National Forest System land, but may also include land under the jurisdiction of the Bureau of Land Management, land under the jurisdiction of the Bureau of Indian Affairs, or other Federal, State, tribal, or private land;

(iii) in need of active ecosystem restoration; and

(iv) accessible by existing or proposed wood-processing infrastructure at an appropriate scale to use woody biomass and small-diameter wood removed in ecological restoration treatments;

(C) incorporates the best available science and scientific application tools in ecological restoration strategies;

(D) fully maintains, or contributes toward the restoration of, the structure and composition of old growth stands according to the pre-fire suppression old growth conditions characteristic of the forest type, taking into account the contribution of the stand to landscape fire adaptation and watershed health and retaining the large trees contributing to old growth structure;

(E) would carry out any forest restoration treatments that reduce hazardous fuels by—

(i) focusing on small diameter trees, thinning, strategic fuel breaks, and fire use to modify fire behavior, as measured by the projected reduction of uncharacteristically severe wildfire effects for the forest type (such as adverse soil impacts, tree mortality or other impacts); and

(ii) maximizing the retention of large trees, as appropriate for the forest type, to the extent that the trees promote fire-resilient stands; and

(F)(i) does not include the establishment of permanent roads; and

- (ii) would commit funding to decommission all temporary roads constructed to carry out the strategy;
- (2) be developed and implemented through a collaborative process that—
 - (A) includes multiple interested persons representing diverse interests; and
 - (B)(i) is transparent and nonexclusive; or
 - (ii) meets the requirements for a resource advisory committee under subsections (c) through (f) of section 205 of Public Law 106-393 (16 U.S.C. 500 note)
- (g) Program Implementation and Monitoring-
 - (2) PROJECT IMPLEMENTATION- Amounts transferred to the Secretary from the Fund shall be used to carry out ecological restoration treatments that are—
 - (A) consistent with the proposal and strategy; and
 - (B) identified through the collaborative process described in subsection (b)(2).

The purpose of the 4FRI Rim Country Project is to restore and maintain the structure, pattern, health, function, and composition and diversity in **forests and grasslands across the landscape** to conditions within the natural range of variation, thus moving the project area toward the desired conditions in the **respective** land management plans. One outcome of restored **forests and grasslands** is increased **ecosystem** resilience. Resilience is the ability of an ecosystem to survive natural disturbances such as fire, insects, disease, and climate change without changing its inherent function (FSM 1909.12, 05; SER 2004). This project is needed to:

- Increase forest and grassland resilience and sustainability
- Reduce hazards associated with undesirable fire effects
- Improve terrestrial and aquatic species habitat
- Improve the condition and function of streams and springs
- Restore woody riparian vegetation
- Preserve cultural resources
- Support sustainable forest products industries
- Improve the motorized transportation system and provide for a more sustainable road system where poorly located roads are relocated or **decommissioned**.

Forest Resilience and Sustainability. There is a need to restore the frequent low-severity fire regimes in which the forest in the Rim Country project area evolved. Resilience increases the ability of the ponderosa pine and mixed conifer-frequent fire forest types (target cover types) to survive natural disturbances and stressors such as fire, insect and disease outbreaks, and climate change (FSM 2020.5).

There is a need to move tree group pattern, interspaces, and stand density toward the natural range of variation. There is a need to manage forest density, structure, and composition to improve forest health and reduce adverse effects from bark beetles and dwarf mistletoe, while also providing a diversity of habitat types and features. In the oak woodland and shrubland cover types, there is a need to stimulate

new growth, maintain vigor in large-diameter trees, encourage faster growth in young smaller oaks, and provide for a variety of shapes and sizes of trees across the forest cover types.

Where aspen is found in the frequent fire forest cover types, there is a need to stimulate growth, reduce conifer encroachment, and increase individual tree recruitment.

In grassland cover types, there is a need to reduce or remove trees and other woody species that have encroached, which has decreased the size and function of these systems that were historically grasslands and functionally connected montane meadows.

There is a need to improve the condition of native plant communities and the resilience of rare species. There is also a need to improve the abundance, diversity, distribution, and vigor of native understory vegetation to provide food and cover for wildlife where it is absent under dense forest stands where fire has been excluded.

Undesirable Fire Effects. There is a need to reduce the risk of undesirable fire behavior and effects, which currently pose a threat to ecosystem function and services, human safety, lives, and values. Restoring fire regimes in forests and grasslands would decrease the risks of post-fire flooding and debris flows that cause loss of soil productivity, water quality, and watershed function. Reducing the potential for undesirable fire effects and reducing excessive fuel loadings would help protect terrestrial and aquatic species habitat as they increase resilience to fires, including areas within and adjacent to Mexican spotted owl habitat.

Terrestrial and Aquatic Species Habitat. There is a need to move the project area toward desired conditions for snags, coarse woody debris, forest structural stages, and stream habitat complexity. There is a need to retain as many old and large trees as possible, in accordance with the Old Tree Implementation Plan and Large Tree Implementation Plan, while moving toward restoration-based desired conditions and recognizing the ecological and socio-political importance of these trees. Where restoration activities occur in the ponderosa pine and dry mixed conifer cover types, there is a need to maintain and promote the development of old growth characteristics and components. There is a need to maintain or improve aquatic habitats to meet needs for fish, frogs, and gartersnakes, recognizing the ecological and socio-political importance of these streams and associated riparian areas.

Streams and Springs. There is a need to improve the condition and function of riparian areas, wet meadows, streams, and springs in the Rim Country project area in order to sustain these features for terrestrial and aquatic habitat, as well as for human use.

Riparian Vegetation. There is a need to restore native riparian vegetation, including large conifers and willows in some cover types, to reduce sedimentation to stream habitat, provide stream shading, maintain cool-water conditions, and provide large wood recruitment to streams to improve habitat complexity.

Cultural Resources. There is a need to reduce threats to cultural resources caused by overly dense vegetation and soil erosion. Though most archaeological sites can tolerate low-severity fire, all are very vulnerable to the effects of high-severity fire in unnaturally high fuel loads and to the soil loss that occurs in post-fire flooding. In particular, there is a need to reduce fuels accumulation around cultural resources to reduce threats to these non-renewable resources.

Forest Products Industries. There is a need to support appropriately-scaled, sustainable, forest products industries that strengthen local economies, while conserving natural resources and aesthetic values. Appropriately-scaled businesses would play a key role in accelerated forest restoration, by harvesting, processing, and selling wood products, thereby reducing treatment costs and providing economic

opportunities. Engaging industry could reduce the cost of removal of forest restoration byproducts by the value of the products removed.

Improved Motorized Transportation System. There is a need to have adequate access for project implementation and decommission temporary roads after use to restore these areas once project activities are completed. In addition, there is a need to decommission unneeded routes identified during the forest Travel Management Rule planning processes as part of the restoration of the landscape in the project area.

Tonto Land Management Plan Amendment - There is also a need to except the Rim Country Project from the 1985 Tonto Land Management Plan with one project-specific amendment containing three different exception areas. These exceptions are for ponderosa pine vegetation/forest cover types, Mexican spotted owl, and mechanical treatments on steep slopes. More information about the amendment can be found in appendix B and chapter 3 contains the analysis of the land management plan amendment substantive requirements.

Exception 1, Ponderosa pine vegetation/forest cover types- This exception is needed to replace land management plan standards and guidelines for ponderosa pine/bunchgrass, ponderosa pine/Gambel oak, and ponderosa pine/evergreen oak, dry mixed conifer and old growth with desired conditions and guidelines, to add a desired condition for basal area and the percentage of interspaces within uneven-aged stands to facilitate restoration, add the desired interspaces distance between tree groups, and add a definition to the Tonto Land Management Plan glossary for the terms interspaces and openings.

Exception 2, the Mexican Spotted Owl (MSO) component- This exception is needed to update definitions, language, and treatment opportunities within Mexican spotted owl habitat to be consistent with the 2012 Mexican Spotted Owl Recovery Plan.

Exception 3, Mechanical treatments on steep slopes- This exception is needed to allow specialized mechanical equipment on slopes greater than 40 percent, to meet the purpose and need of the Rim Country Project, and to move toward desired conditions on steeper slopes in the project area.

Public Involvement

Collaboration and Public Involvement

Collaboration with interested publics, agencies, tribes, and other organizations has been critical to shaping the planning process and alternatives analyzed in this EIS. Collaboration and public involvement have occurred consistently throughout the development of the Rim Country Project through informal and formal opportunities. Informal opportunities have consisted of 4FRI Stakeholder and 4FRI Stakeholder Working Group meetings, field trips, and feedback provided to the Forest Service interdisciplinary team. Formal opportunities have consisted of the scoping and comment period, public meetings, workshops, and opportunities for document review.

The following is an overview of these formal opportunities:

2016:

- The Rim Country Project has been published in the Apache-Sitgreaves, Coconino, and Tonto National Forests' Schedule of Proposed Actions (SOPA) since January of 2016. As the Rim Country project area was developed, the Forest Service worked with stakeholders to define the

project boundary as well as the extent of the analysis through multiple meetings, presentations, and field visits.

- Release of the Rim Country Draft Proposed Action and Purpose and Need description document for public viewing. On May 10, 2016, a public meeting in Payson, Arizona, occurred to discuss and gain feedback on the draft proposed action and purpose and need.
- A 45-day scoping period occurred from June 27 to August 11, 2016. The notice of intent to prepare an EIS was published in the Federal Register on June 27, 2016 (81 FR 41517). A scoping document was posted on the project website (www.fs.usda.gov/goto/4FRIRimCountry) and mailed to all known potentially interested parties including 676 individuals, local governments, state governments, federal and state agencies, and organizations that engage with all three national forests, inviting public comment on the proposed action. Public workshops were held on July 14, 2016 in Show Low, Arizona, and on July 21, 2016 in Payson, Arizona, to discuss the proposed action and accept comments. Fifty responses (e-mails, letters, and public meeting comment forms) were received from this scoping effort.

2017:

- Preliminary alternatives considered for Rim Country were first posted to the Forest Service 4FRI website and shared with the 4FRI Stakeholder Group in March of 2017. Alternative development workshops were held on April 13, 2017 in Payson, Arizona, and on April 18, 2017 in Show Low, Arizona, to gain input on the preliminary alternatives. The Forest Service interdisciplinary team reviewed the feedback received to further refine the alternatives.
- Additional presentations on the Rim Country alternatives were given to the 4FRI Stakeholder Group in July and November 2017, discussing the progression of the action alternatives that would be analyzed in the DEIS. In November 2017, a working draft of the action alternatives and the flexible toolbox approach (now called condition-based management) were shared with the public and 4FRI Stakeholder Group. Collaboration on the Mechanical Treatments and Aquatics and Watershed Restoration Condition-based Management Approaches with the 4FRI Stakeholder Group, AZGFD, and Trout Unlimited took place throughout 2017 with various meetings, presentations, and field visits.

2018:

- In January 2018, an updated working draft of the action alternatives was shared with the public and 4FRI Stakeholders.

2019:

- On September 25, 2019, a preliminary version of the DEIS was shared with the 4FRI Stakeholder Group and posted to the Forest Service Rim Country public website. Comments were accepted on the preliminary version and reviewed by the interdisciplinary team.
- On October 19, 2019, a notice of availability for the DEIS was published in the Federal Register (84 FR 55952). Rather than a 45-day comment period as per regulations (36 CFR 218 subparts A and B), the Forest Service chose to complete a 90-day comment period due to the complexity of the project to allow for meaningful public participation. The Forest Service also posted the notice of availability in the official newspapers of record for the three forests that includes the *Arizona*

Republic, White Mountain Independent, Arizona Daily Sun, Arizona Capital Times, and the Payson Roundup. The Forest Service hosted three public meetings on the following dates: November 12, 2019: 5:30-7:30 p.m., Payson and Pleasant Valley Ranger District Office, 1009 East Highway 260 Payson, Arizona; December 2, 2019: 5:30-7:30 p.m., Black Mesa Ranger District Office, 2748 East Highway 260 Overgaard, Arizona; and December 3, 2019: 5:30-7:30 p.m., Arizona Game and Fish Department Region II Office, 3500 S Lake Mary Rd, Flagstaff, Arizona. The Forest Service received 52 comment letters and emails regarding the DEIS from individuals, Tribal governments, Federal, State, and local agencies, organized interest groups, and businesses. Comments were received from several government agencies including Coconino County, Arizona Department of Environmental Quality, U.S. Environmental Protection Agency, and Arizona Game and Fish Department.

Cooperating Agencies

On July 15, 2015, the Arizona Game and Fish Department (AZGFD) became a cooperating agency for the Rim Country Project. The AZGFD specialists served on the interdisciplinary team for the Rim Country Project, helped develop the proposed action and other action alternatives, provided existing conditions for species and their habitat, and reviewed, edited, and augmented species analysis. The AZGFD specialists attended interdisciplinary team meetings, held workshops to gather aquatic and terrestrial wildlife data, and provided existing condition and location information (tabular and spatial) for priority species.

Stakeholder Involvement

As part of CFLRP eligibility and to ensure the project was developed and implemented through a collaborative process, 4FRI has an active stakeholder group that is transparent, nonexclusive, and includes many interested persons representing diverse interests. The 4FRI Stakeholder Group, and in particular the work groups, have been active and worked tirelessly to ensure the success of the Rim Country Project. Throughout the lifetime of 4FRI, the Forest Service and 4FRI Stakeholder Group extensive engagement has culminated in a high level of agreement surrounding landscape-scale forest restoration that is unprecedented. This tireless work and success has resulted in recommendations for landscape-scale restoration, spatial priorities for treatments, general intensities for treatments, overall scale of restoration needed, and the need for and quantity of wood and biomass available for appropriately-scaled wood products industries.

A memorandum of understanding (MOU) between the Forest Service and the 4FRI Stakeholder Group was signed in February 2011. The MOU outlines a framework of collaboration by all parties involved and interested in the restoration of northern Arizona's ponderosa pine forests, and the cooperative relationship among the parties, in accordance with three main goals. The MOU states that the Forest Service, the 4FRI Stakeholder Group, along with the public at large, will work together at multiple stages prior to, during, and following the NEPA process to establish expectations for landscape-scale restoration and on such products as the purpose and need statement, proposed action, alternatives, collection and use of data, and development of monitoring and adaptive management processes, subject to/consistent with applicable federal laws, regulations, land management plans, and other management direction. The 4FRI forests and the interdisciplinary team have worked closely with the stakeholder group to meet the intent of the MOU for the Rim Country Project.

Large and old tree retention has been a central focus of 4FRI Stakeholder Group as expressed in The Path Forward (March 24, 2010), the Old Growth Protection & Large Tree Retention Strategy (September 13, 2011), the Statewide Strategy for Restoring Arizona's Forests (Governor's Forest Health Council 2007), and in developing guidance for Stands with a Preponderance of Large Young Trees (September 27, 2017).

The 4FRI Stakeholder Group has also worked with researchers and managers to incorporate monitoring science within the collaborative planning processes. A collaborative, science-driven, monitoring and adaptive management strategy was developed to address long-term ecological questions through systematic, applied, and question-driven science (see appendix E). Results of such efforts will be used to inform ongoing planning and implementation of the Rim Country Project.

After the DEIS comment period, from 2019 to 2021, extensive collaboration between the 4FRI Stakeholder Group and the Forest Service occurred to respond to the comments received from the 4FRI Stakeholder Group. The 4FRI Stakeholder Group formed an FEIS working group that included stakeholders, USFWS, AGFD, and other partners that met regularly with the Rim Country interdisciplinary team to address concerns including the condition-based management approach, openness, old and large trees, dwarf mistletoe treatments, pre-treatment conditions, and the need for collaborative implementation. Extensive collaboration with the 4FRI Stakeholder Group's Multi-Party Monitoring Board also occurred including input and review of appendix E: Monitoring and Adaptive Management Plan.

Tribal Consultation

Each forest consulted with specific tribes to reduce redundancy of information sharing and comments gathered by each forest liaison shared with the other forests. Tribes who received invitations to consult on the project include: the Hopi Tribe, Havasupai Tribe, Hualapai Tribe, Kaibab Band of Paiute Indians, San Juan Southern Paiute Tribe, Fort McDowell Yavapai Nation, Yavapai-Apache Nation, Yavapai-Prescott Indian Tribe, Mescalero Apache Tribe, San Carlos Apache Tribe, Tonto Apache Tribe, White Mountain Apache Tribe, Pueblo of Acoma, Pueblo of Zuni, Gila River Indian Community, Salt River Pima–Maricopa Indian Community, Navajo Nation, and Navajo chapters in proximity to the project area including: the Alamo, Bodaway/Gap, Cameron, Coalmine Canyon, Dilkon, Lechee, Leupp, Ramah, Tolani Lake, and To'Nanees'Dizi Chapters.

On July 1, 2016, the Rim Country Project proposed action was sent to each Tribe along with an invitation to formally consult with the Forest Service. This resulted in various phone calls, emails, and consultation meetings. One written scoping response was received from the Hopi Tribe in which the Tribe requested continued consultation on implementation and review of cultural resource surveys, Traditional Cultural Properties, and ethnographic studies. On April 6, 2017, the Archaeological Site Treatment strategy was distributed to tribes for comment.

As a result of consultation, design features were added to protect and enhance traditionally used plants, (including Emory oak, sumac berries, tobacco) that are at risk or have been identified as culturally, medicinally, or economically important to tribal communities. Opportunities to harvest plants before implementation will be provided to Federally recognized tribes whose traditional territory is within the project area.

The tribal relations section in chapter 3 and tribal relations specialist report provide more information and complete documentation of consultation and engagement opportunities through the project.

Issues

Issues are statements of cause and effect, linking environmental effects to proposed activities. Comments from the public, the 4FRI Stakeholder Group, other agencies, tribes, and Forest Service personnel were used to formulate issues concerning the proposed action. All comments received were reviewed and analyzed by the interdisciplinary team to “...identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review...” (Council on Environmental Quality, Sec. 1506.3; 40 CFR 1501.7(a) (3)). Non-significant issues were identified as those: (1) outside the scope of the proposed action; (2) already decided by law, regulation, land management plans, or other higher-level decision; (3) irrelevant to the decision to be made; or (4) conjectural and not supported by scientific or factual evidence. Significant issues were identified as those directly or indirectly caused by implementing the proposed action. Significant issues were grouped by issues that can be responded to through mitigation measures and those that were responded to in alternatives to the modified proposed action.

The public comments received during the scoping period from June 27 to August 11, 2016 presented seven **significant** issues that are within the scope of the analysis, and relevant to the decision to be made. These significant issues were used to modify the proposed action and formulate a new action alternative for the analysis.

Significant Issues Responded to through Mitigation Measures, Analysis, and Modifications to the Proposed Action

Issue 1 – Treatments in Mexican spotted owl protected activity centers

The proposed action may have negative effects on Mexican spotted owl by cutting trees up to **18** inches in diameter in Mexican spotted owl protected activity centers. The Forest Service should act conservatively to protect Mexican spotted owl habitat and consider all cautions identified in the revised Recovery Plan for Mexican spotted owl (USDI Fish and Wildlife Service 2012). There is a concern about how Mexican spotted owl will respond to the removal of trees up to **18** inches in diameter, given a lack of monitoring data.

How Issue 1 is addressed

This issue is addressed in the effects analysis for all alternatives using the best available science and with design features and conservation measures as outlined in the 2012 revised Mexican spotted owl Recovery Plan to apply to treatments in Mexican spotted owl protected activity centers. The wildlife analysis will reference all available monitoring information from the 1st 4FRI EIS and from other sources across the region.

Indicators/Measures

Indicators will include changes in the amount and quality of Mexican spotted owl nest/roost habitat within protected activity centers. Specific measures include:

- Basal Area Average, Trees per Acre greater than 18 inches, Canopy Cover, and increases of large tree size classes greater than 18 inches diameter at breast height by alternative in Mexican spotted owl habitats,
- Fuel loading, fire hazard index, and risk of crown fire, and
- Prey habitat as measured by number of snags per acre 12 inches or greater in diameter, coarse woody debris, and shrub and herbaceous cover.

Issue 2 – Treatments in Northern Goshawk Habitat

The proposed action may have negative effects on northern goshawk and canopy-dependent prey species by reducing late seral, dense understory, and old growth habitat. Specifically, there is a concern that treatments will reduce the mix of densities and cover types, including later seral stages.

How Issue 2 is addressed

This issue is addressed in the effects analysis for all alternatives, and with design features and conservation measures as outlined in the most current management recommendations to apply to treatments in northern goshawk habitat.

Indicators/Measures

Indicators will include changes in the amount and quality of northern goshawk nesting and foraging habitat. Specific measures include:

- Basal Area Average, Trees per Acre greater than 18 inches, Canopy Cover, and increases of large tree size classes greater than 18 inches diameter at breast height by alternative in Mexican spotted owl habitats,
- Fuel loading, fire hazard index, and risk of crown fire, and
- Prey habitat as measured by number of snags per acre 12 inches or greater in diameter, downed logs, coarse woody debris, and shrub and herbaceous cover.

Issue 3 – Large Tree Retention

The proposed action may cause the loss of large trees which may significantly affect old growth recruitment. Proposed management actions in old growth, future old trees (large young trees), and high-canopy patches should be very explicit, and no old trees be cut.

How Issue 3 is addressed

This issue is addressed in the effects analysis for all alternatives. Large tree retention will be addressed with incorporation of the Old Tree Implementation Plan (OTIP) and the Large Tree Implementation Plan (LTIP) as well as treatment design and location, design features, mitigation measures, and best management practices to retain old growth and large trees in accordance with the OTIP and LTIP in all action alternatives. The OTIP and LTIP (appendix D) were developed collaboratively with the 4FRI Stakeholder Group and are incorporated into all action alternatives.

Indicators/Measures

- Number of acres of stands meeting collaboratively developed using a Stands with an Abundance of Large Trees (SALT) criteria.

Issue 4 – Dwarf Mistletoe Mitigation

Dwarf mistletoe treatments were originally included in the proposed action and included the removal of some of the larger trees in infected stands. The scale and intensity of mistletoe mitigation were defined and included a range of treatments depending on the severity and extent of infection and analyzed in the DEIS. The proposed action allowed natural levels to be allowed to remain to provide essential food and occupancy needs to wildlife, and that the mitigation treatments not only focus on removing the largest trees. After review of comments on the DEIS and subsequent collaboration, dwarf mistletoe treatments were removed from the project. Dwarf mistletoe will instead be handled by individual tree removal criteria (see the Implementation Plan in appendix D for the criteria).

Issue 5 – Economics

The proposed action does not include measures to make it economically viable. A wide range of options should be considered in the action alternatives that would allow for biomass removal where economically feasible but would also allow other options to dispose of uneconomically feasible biomass.

How Issue 5 is addressed

To improve the economic viability, analysis of the development and use of 12 in-woods processing sites to increase the utilization of forest products and transportation efficiencies is included in both action alternatives. **Alternative 2 contributes to economic viability because the most acres are treated.** Alternative 3 focuses on those areas most highly departed from the natural range of variation of ecological conditions and/or that put communities at risk from undesirable fire behavior and effects. This issue will be included in the analysis in this **FEIS**, the Implementation Plan (appendix D), and will also be addressed during implementation as opportunities for biomass removal are developed.

Indicators/Measures

- Volume of wood products (ccfs and biomass dry tons) available for removal by restoration activities.
- Unit and overall project net treatment costs.
- Economic efficiency (project benefits/value less project costs).
- Changes in employment (annual jobs created) and labor income.

Significant Issues Responded to in Alternatives to the **Modified Proposed Action**

Issue 6 – Smoke/Air Quality

The proposed prescribed burning may have negative effects on air quality and human health. Some commenters are concerned that the smoke from prescribed burns will degrade air quality and the health of northern Arizona residents.

How Issue 6 is addressed

Alternative 3 was partially developed to respond to this issue. It includes fewer acres of prescribed burning than alternative 2. An alternative that proposed no prescribed fire was considered but eliminated from detailed study (see chapter 2). This issue will be addressed in the effects analysis for all alternatives. Design features and/or mitigation measures will be included to minimize effects on air quality from prescribed fires.

Indicators/Measures

The potential for emissions from proposed prescribed fire to affected communities will be evaluated qualitatively. The pollutants to be modeled include the six listed in the Clean Air Act for which there are National Ambient Air Quality Standards: carbon monoxide (CO), nitrogen dioxide (NO₂), particulate matter less than 10 microns in size (PM 10), particulate matter less than 2.5 microns in size (PM 2.5), ozone (O₂), and sulfur dioxide (SO₂). There will be a discussion on the ecological effects of smoke, and the socioeconomic analysis will evaluate the effects of smoke on the quality of life and tourism.

Issue 7 – Roads

The miles of temporary roads in the proposed action may negatively affect watershed and stream conditions, and wildlife habitat and connectivity. Commenters asked that the Forest Service limit road networks to those roads needed for access and management. Commenters requested an alternative that dramatically reduces temporary road mileage.

How Issue 7 is addressed

Alternative 3 was partially developed to respond to this issue. It includes the least number of miles of temporary roads. Design features and/or mitigation measures will be developed to reduce effects on watersheds, streams, and wildlife habitat. This issue will be addressed in the effects analysis for all alternatives.

Indicators/Measures

Indicators will include the range of temporary roads that may be needed in each of the alternatives, measured by the approximate number of miles of temporary roads proposed in each alternative.

Changes from the DEIS to the FEIS

The Forest Service considered all substantive comments and used them to assist in updating, changing, or adding clarifications to the FEIS. The FEIS changes include consideration given to public comments, corrections, and minor grammatic changes including rewording for clarification of purpose and intent. The Forest Service focused on addressing public comments, while continuing to meet its legal, regulatory, and policy mandates. No additional alternatives have been evaluated in the FEIS. Key changes to the FEIS include:

- Purpose and Need
 - Changed ponderosa pine ecosystem to include other vegetation cover types to reflect that cover types other than ponderosa pine, occur within the project area and would be restored.
 - Changed text in the Forest Product Industries section of the purpose and need to state that engaging industry could reduce the cost of removal of byproducts.
 - Updated Tonto Land Management Plan Amendment text to capture that the Rim Country Project is proposing one plan amendment, with three exceptions.
- Changes to the Alternatives
 - Single tree selection removed as a treatment.
 - Intermediate thinning removed as a treatment.
 - Added hand-thinning as a treatment.
 - Updated mechanical treatments within Mexican spotted owl protected activity centers, which resulted in reduction of treatment acres.
 - Updated protected activity center and core area boundaries and included additional protected activity centers that were found between the DEIS and FEIS.
 - Clarification was added that comprehensive restoration activities proposed within other NEPA projects would still occur under both alternatives 2 and 3.
 - Clarification was added on mechanical thinning treatment types.

- Under other NEPA project areas (Areas Covered Under Other NEPA Decisions for Inclusion of Restoration Activities section, figure 5), prescribed fire only in the Rim Lakes project area, within new Mexican spotted owl protected activity centers in the Upper Beaver Creek project area, and within the Mexican spotted owl core areas of the Clint's Well project area was added for alternative 2.
- Modifications have been made to Chapter 2 to clarify the alternatives including elements and activities that are common between the action alternatives. Clarification includes moving and updating the "Elements Common to Action Alternatives" section above alternatives 2 and 3 and relabeling it "Elements and Activities Common to Action Alternatives." Clarification has also been added to this section so that it is clear that there are specific elements (the implementation plan, design features, plan amendment exceptions) that apply to both action alternatives. Additionally, there are many activities (comprehensive restoration and in-woods processing sites) that are common to both action alternatives and these activities have been presented in this section. Clarification was added to this section as well to improve readability.
- The Flexible Toolbox Approach is now called the Condition-based Management approach. The condition-based management approach has been clarified in the FEIS from the DEIS in order to be more predictable, reliable, and repeatable and includes:
 - Additional integration between aquatic and upland restoration activities.
 - Development of a treatment tracking process to identify accomplishments and validate effects.
 - A list of priority areas for aquatic and watershed restoration provided by Arizona Game and Fish Department.
 - Openness
 - Interspace has been removed as a treatment metric and replaced with basal area and trees/acre. The term Interspace will still appear in this FEIS and may be used to facilitate project implementation in addition to these primary treatment metrics (see appendix D).
 - Removal of regeneration openings.
 - Mapping of wildland urban interface/infrastructure protection treatments extent and location.
 - Old and Large Trees
 - Redefined definition of SPLYT. This is now termed SALT and is compatible with condition-based management.
 - Redefined category 8 of Large Tree Implementation Plan (Appendix D).
 - Old trees are now defined as greater than 150 years old.
 - The Implementation Plan (Appendix D) now uses Thomson (1940) and photo guide for old tree identification
 - Dwarf mistletoe-specific treatments have been removed from alternatives 2 and 3. Dwarf mistletoe will be handled by individual tree removal criteria.

- Updated the project boundaries for treatments that have occurred and are being implemented for “Areas Covered Under NEPA Decisions for Inclusion of Restoration Activities” on the Tonto National Forest.
- Added a tabular summary of treatment types by cover types.
- The design features (appendix C) have been updated.
- Updated the Monitoring and Adaptive Management Plan (appendix E) in collaboration with 4FRI Stakeholder Group.
- Updated the Implementation Plan (appendix D) with collaboration from 4FRI Stakeholder Group and input from the interdisciplinary team.
- Inventoried roadless areas were added to chapter 1, chapter 2, and an analysis was added to chapter 3.
- Added Apache County to list of counties and updated the analysis to reflect the change.
- Updated rationale for eliminating the strategic treatments for fire use alternative.
- Added information on alternative development.
- Specialist reports were updated to reflect changes to alternatives 2 and 3, including updated modeling. Changes to direct, indirect, and cumulative effects are reflected in chapter 3 of the FEIS.
- For consistency, sections from the specialists reports that are not new analysis were added. These additions are spelled out throughout the FEIS.
- Updated the Tonto National Forest land management plan amendment substantive requirements section in chapter 3 and provided additional details in appendix B.
- Developed appendix F. Mexican spotted owl Recovery Plan Framework to respond to requirements for the Mexican spotted owl.
- Added or updated glossary terms in appendix G.
- Appendix H. Response to Comment details other changes from DEIS to FEIS.
- Additional literature citations have been added to the references cited.

Decision to be Made

The Apache-Sitgreaves, Coconino, and Tonto National Forest Supervisors are the officials responsible for the Rim Country Project decision. Based on the purpose and need for action, the findings in the EIS and supporting project record, and consideration of the best available science, the responsible officials’ decision will include:

- Selecting one of the alternatives analyzed or selecting an alternative that combines activities proposed in the different alternatives analyzed. This “blending” of alternatives must be a mix of proposed activities for which the Rim Country analysis discloses the effects.
- Deciding which, if any, of the proposed 1985 Tonto Land Management Plan amendment exceptions to approve and whether one or more amendment exceptions would affect the plan’s inherent capability of meeting the substantive requirements in the 2012 Planning Rule.
- Deciding on the design features, best management practices, and conservation and mitigation measures to be used during implementation.

- Establishing the Implementation Plan and the Monitoring and Adaptive Management Plan prepared with the Multi-party Monitoring Board.

Chapter 2. Alternatives, Including the Proposed Action

This chapter describes and compares the alternatives considered for the Rim Country Project. It includes a description of each alternative considered. Maps for the alternatives can be found in appendix A. This section also presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. Some of the information used to compare the alternatives is based upon the design of the alternative and some of the information is based upon the environmental, social, and economic effects of implementing each alternative.

Alternative Development

The action alternatives have been modified as a result of the scoping period, alternative development workshops, the DEIS comment period, interdisciplinary team input, and extensive collaboration and public involvement since June 2016 (see Chapter 1 - Public Involvement). Modifications to the alternatives include but are not limited to:

- from scoping to publication of the DEIS, adding the 40 percent slope amendment exception to the 1985 Tonto Land Management Plan amendment;
- from scoping to publication of the DEIS, dropping the cultural resources amendment exception because the Tonto National Forest completed the amendment separately in 2017;
- dropping the even-aged shelterwood treatments originally proposed and replacing them with other treatments as assigned by the condition-based management process;
- providing clarity, details, and definitions of key terms used such as cable operations, arterial road, collector road, hand thinning, mechanical thinning, mechanical treatments, interspace, and openness (appendix G. Glossary);
- defining the proposed treatments and terms in more detail;
- from scoping to publication of the DEIS, elimination of the proposal to mechanically thin trees and implement prescribed fire on approximately 1,260 acres in the Long Valley Experimental Forest from this alternative and Rim Country Project based on discussions with the Rocky Mountain Research Station. Experimental treatments for the experimental forest would be analyzed in a separate NEPA analysis; and
- updating the acreages and miles of proposed treatments based on additional modeling. Further development of the condition-based management process provided more accurate estimates of specific treatments acres based on the best available data across the project area.

The Changes from DEIS to the FEIS section (see Chapter 1) contains a detailed list of changes to the alternatives and other sections of the FEIS based on public involvement during the DEIS comment period.

Those concerns that could not be addressed through modifications and additions to the Proposed Action were considered significant issues (see the Issues section in Chapter 1). Two of these issues drove the development of an additional action alternative (Alternative 3 Focused Restoration) presented in the DEIS. There were no additional issues identified during the DEIS comment period requiring an additional action alternative in the FEIS.

During the alternative development process, many different iterations of alternatives were presented such as alternatives that included maximum functional restoration, extended duration restoration, and various iterations of alternative 2. The development of those alternatives and extensive coordination with the stakeholder group and the public has resulted in the current form of the alternatives 2 and 3.

Areas Covered Under Other NEPA Decisions for Inclusion of Restoration Activities

Approximately 199,000 acres already covered by NEPA decisions are included in the Rim Country analysis in order to incorporate additional restoration activities such as prescribed fire, road decommissioning, spring and stream channel restoration, and riparian habitat restoration. Within the project area, about 98,000 acres (figure 5) have been excluded from analysis because they are not National Forest System lands, or are included in other restoration NEPA projects that already have decisions.

- Approximately 37,000 acres have been excluded from being incorporated into treatment proposals because they are non-Forest Service lands. Past, present, and reasonably foreseeable actions on these lands are addressed under cumulative effects in chapter 3.
- Approximately 61,000 acres have been excluded because they are already covered by NEPA decisions, with treatments designed to meet restoration objectives. These past and ongoing projects will be addressed in cumulative effects in chapter 3.

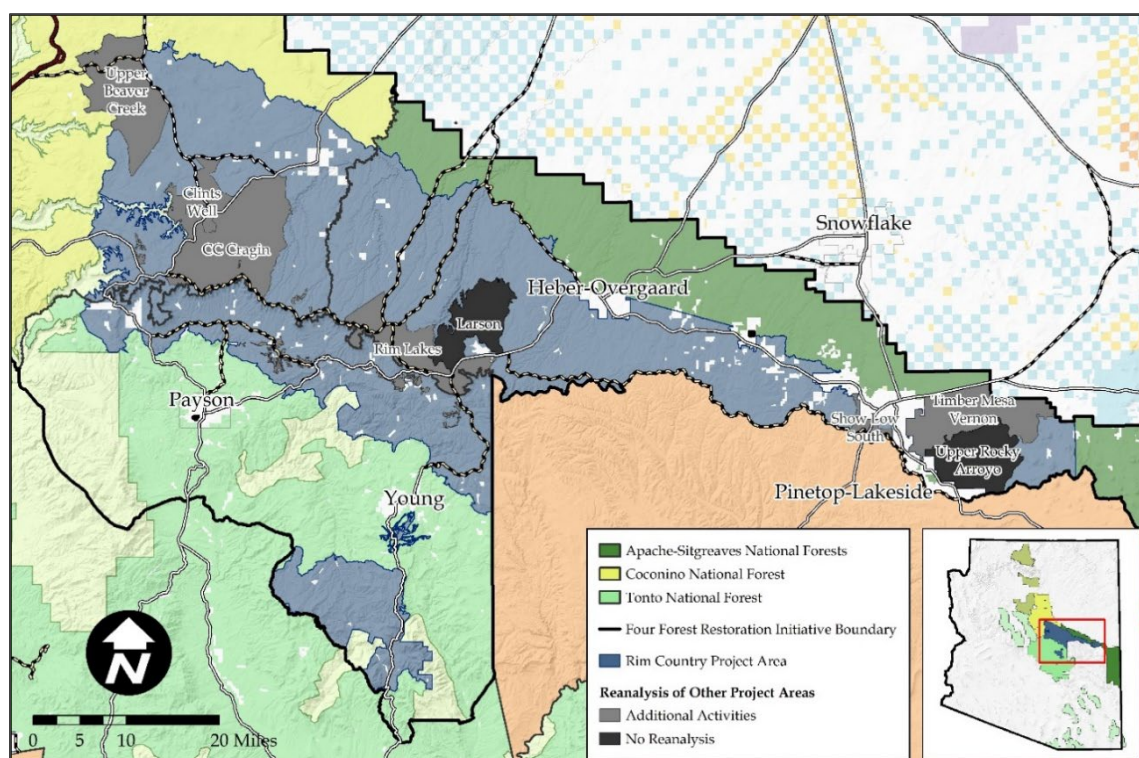


Figure 5. Other projects within the 4FRI Rim Country project area

Alternatives Considered in Detail

This FEIS documents the analysis of three alternatives, including no action (alternative 1); the Modified Proposed Action (alternative 2), which is the preferred alternative; and focused restoration (alternative 3). Alternative 2 (as modified) and alternative 3 respond to issues raised by the public during the scoping period. The alternatives are described below.

Alternative 1 – No Action

Alternative 1 is the no action alternative, as required, and represents no changes to current management; current land management plans would continue to be implemented. Ongoing vegetation treatments and fire management activities, as well as road maintenance, recreation, firewood gathering, authorized livestock grazing, and other activities already authorized in separate NEPA decisions would continue. There would be no other restoration activities approved with the Rim Country Project. The potential direct, indirect, and cumulative effects from no action will be analyzed. The no action alternative is the baseline for assessing the action alternatives (alternatives 2 and 3).

Elements and Activities Common to Alternatives 2 and 3

Because the Rim Country restoration activities focus on moving conditions within the natural range of variation, the action alternatives (alternatives 2 and 3) are all guided by the same strategy for restoration and would have certain key project elements or activities that are common. To avoid redundancy, this section presents an overview of project elements and activities that would be implemented with all action alternatives (alternatives 2 and 3) for restoration activities. These commonalities make up the bulk of the alternatives and respond to many of the concerns and issues brought up during the scoping and comment periods.

The elements described below are essential components of the alternatives that are common between the action alternatives. These elements are fully described in appendices to the FEIS and the “Elements Common to Both Action Alternatives” section below provides an overview of the elements.

Elements that are common between the alternatives include:

- Tonto National Forest Land Management Plan amendment (appendix B),
- design features (appendix C),
- the implementation plan that includes the old and large tree implementation plans, and the condition-based management approach (appendix D), and the
- monitoring plan (appendix E).

The proposed activities described below are actions that are common between the action alternatives and a description of these actions can be found in the “Activities Common to Both Action Alternatives” section below.

Proposed activities that are common between alternatives include:

- mechanical and prescribed fire treatments definitions,
- comprehensive restoration activities,
- in-woods processing and storage sites, and
- rock pit expansion and use.

Elements Common to Alternatives 2 and 3

Land Management Plan Amendment – Tonto National Forest

One project-specific amendment with three exceptions to the Tonto National Forest Land Management Plan are evaluated in the Rim Country Project Final Environmental Impact Statement (FEIS) for alternatives 2 and 3. The proposed land management plan amendment is in accordance with 36 CFR 219, the Forest Service 2012 Planning Rule (USDA 2012c). This amendment is a project specific, one-time variance from the current 1985 Tonto National Forest Land Management Plan direction for the Rim Country Project. This amendment applies only to the Rim Country Project for the area within the Tonto National Forest. There is no need for a project specific amendment to the Apache-Sitgreaves or Coconino National Forest land management plans because they were recently revised to reflect current science, policy, and technology.

To align the Tonto National Forest 1985 land management plan standards and guidelines with best available scientific information, a project-specific plan amendment (with three exceptions) is proposed under alternatives 2 and 3. The three exceptions include:

- Exception 1. Ponderosa pine vegetation treatment/forest cover types: would except the project from the current 1985 land management plan standards and guidelines for old growth to better align with the best available science (such as, Reynolds et al. 2013) and with the direction in the Tonto's proposed revised land management plan. The proposed revised plan provides for old growth through desired conditions and objectives for restoring fire-adapted ponderosa pine in the Southwest. This exception also clarifies the current interpretation for meeting the canopy cover requirements in the land management plan.
- Exception 2. Mexican spotted owl component: would except the project from the outdated plan direction that reiterates the original Mexican Spotted Owl Recovery Plan (1995) and to bring it into alignment with the current Mexican Spotted Owl Recovery Plan, First Revision (2012). Specifically, it would except the project from the monitoring requirement in the 1985 land management plan and would instead implement the monitoring specified in the U.S. Fish and Wildlife Service (USFWS) biological opinion specific to this project.
- Exception 3. Mechanical treatments on steep slopes: would except the project from the land management plan direction limiting the use of mechanical equipment to slopes less than 40 percent and identifying slopes above 40 percent as inoperable. The proposed amendment would allow the use of mechanized ground-based equipment to thin on slopes greater than 40 percent where it is not otherwise restricted and while minimizing the effects on soil and water resources. This exception reflects that advances in technology (Holzfeind et al. 2020) that is used across the country and would allow for restoration treatments to be implemented on steeper slopes, to meet the purpose and need of the Rim Country Project to move toward desired conditions in these areas, while meeting the original intent of the standard/guideline.

Substantive analysis requirements as per the 2012 Planning Rule (36 CFR 219.8 and 219.9) are addressed within chapter 3. This amendment is a one-time variance in the 1985 Tonto National Forest land management plan direction specifically for the Rim Country Project. Appendix B contains the specific standards and guidelines that would be amended and the amendment language.

Design Features, Best Management Practices, Conservation and Mitigation Measures

The Forest Service employs several measures in the planning and implementation of management activities to reduce or prevent negative effects on the environment. The application of these measures

begins in the planning and design phase of a project. Land management plan standards and guidelines and the direction contained in the Watershed Conservation Practices Handbook (FSM 2509.25) are protection measures applied to any project. Both of these sources are incorporated by reference.

Project design features, best management practices, and conservation and mitigation measures that are designed to minimize or avoid effects from the proposed activities have been included in the analysis (see appendix C) and apply to both alternatives 2 and 3.

Implementation Plan

The implementation plan (appendix D) is designed to be integral to the selected alternative and record of decision. It must be considered in conjunction with appendix C, which provides the design features, best management practices, and conservation and mitigation measures. The implementation plan provides direction to be used by Forest Service personnel to ensure that management activities are implemented to meet the purpose and need for Rim Country and to follow land management plan standards and guidelines. The Implementation Plan includes:

- Implementation Checklist,
- Old Tree Implementation Plan (OTIP),
- Large Tree Implementation Plan (LTIP),
- Rim Country Condition-based Management Approach for mechanical and aquatic and watershed restoration activities,
- Management Direction, Desired Conditions and Treatment Design, and
- Permits and other law, regulations, and policy requirements the project would follow.

Old Tree Implementation Plan and Large Tree Implementation Plan

The Old Tree and Large Tree Implementation Plans (appendix D) provide additional direction on the retention of old and large trees and are considered a part of action alternatives.

Condition-based Management Approach

Condition-based management is being used for mechanical treatments (and prescribed fire), and aquatics and watershed restoration activities. The two condition-based management approaches would use different types of decision-making processes. The mechanical treatments condition-based management approach uses a process based on vegetation or stand conditions to determine the appropriate mechanical and/or fire treatments to prescribe. The aquatics condition-based management approach uses a different type of process for implementation of and prioritizing restoration projects. These two Condition-based Management approaches are included in appendix D of this EIS, the Implementation Plan, in their entirety.

Figure 6 diagrams the process used in the condition-based management approach for mechanical treatments for assigning mechanical and fire treatments. Table 14 lists the considerations used in the condition-based management approach for prioritization of aquatics and watershed restoration activities.

In order to place the right treatment in the right location to meet the desired condition most effectively, the Rim Country Project will use a condition-based management as an approach (figure 6) for treatment allocation. This type of approach does not assign specific treatments to specific acres, but rather assigns treatments to a set of conditions that occur on the landscape. Once these conditions are identified by an interdisciplinary team, the implementation plan (appendix D) is applied to identify the appropriate

treatment. The need for this approach is derived from applying adaptive management considerations and lessons learned from past related projects.

Condition-based management begins with an initial project resource review of forest conditions and site-specific considerations that inform the condition-based management process. This process would include the consideration of the integration of upland and aquatic restoration treatments. The area would then be evaluated for special management considerations that would result in a specific treatment assignment, such as protected activity centers, Mexican spotted owl recovery nest/roost habitat, wildland urban interface, severe disturbance areas, and others. Areas that do not fall within the special management considerations would be limited to the ponderosa pine, ponderosa pine/evergreen oak cover type as well as Mexican spotted owl foraging non-breeding ponderosa pine oak and dry mixed conifer habitat. These areas would be assigned a treatment using a decision tree. Finally, a set of decision tree modifiers would be used to identify an appropriate treatment intensity within the ranges describe by the decision tree. The result would be an ecologically appropriate treatment that would best meet the desired condition across the landscape.

Condition-based management is an approach that allows predetermined treatments to be aligned, prior to implementation, with current conditions on the ground. A combination of selection criteria and vegetation conditions are used to determine habitat and forest cover filters and modifiers, as well as the appropriate treatments for each. Using existing stand data, these conditions and criteria are quantified to estimate the acreages of specific treatments to propose in a project area. These estimates are used to analyze the effects from those treatments. Site-specific field reviews are conducted before implementation to verify that ground conditions match those predicted. If they do not, the same selection criteria are applied again based on the actual ground conditions to be sure that the right treatment occurs on the right acre.

Condition-based management:

- Gives the ability to obtain more detailed site-specific information.
- Adapts to changes in environmental conditions.
- Uses expected conditions to make an informed decision about what types of treatments would work best in those conditions.
- Encourages application of the appropriate tool based on site conditions at time of implementation.
- Uses site-specific landscape features and current site conditions during implementation to guide selection of specific treatments or tools to move areas toward desired conditions and put the right treatment in the right place.
- Gives resource specialists flexibility to increase heterogeneity across the landscape by varying the extent, type, or intensity of treatments within the range of the assigned treatment.

Condition-based management is used to:

- Identify forest cover and habitat types that warrant special consideration and require additional management constraints. These include Mexican spotted owl protected activity centers, Mexican spotted owl nest/recovery habitat, aspen restoration, facilitative operations, severe disturbance areas, wildland urban interface, eligible wild and scenic river corridors, grass, and savanna. The Aquatics Condition-based Management approach allows specialists to choose from a variety of tools designed for specific site conditions.

- Develop a decision tree, or decision-making process, to display the different site conditions that would lead to different treatments in areas outside of filters. While treatments in some cover and habitat types will not be determined by the decision tree, others will make use of the decision tree with added design features or “modifiers” to ensure resource protection. These include Mexican spotted owl Recovery Habitat, NOGO Nest Stands, NOGO PFAs, eligible wild and scenic rivers, stands infected with dwarf mistletoe, inventoried roadless areas, and SALT stands.
- Estimate the number of acres of each type of treatment proposed in each of the action alternatives. Proposed treatments, each with a defined range of basal area are analyzed toward the higher end of treatment intensity, in order to analyze the maximum potential effects from these treatments. More information on post-treatment basal areas is provided in Appendix D, the Implementation Plan.
- Prescribe appropriate treatments during implementation. Pre-implementation surveys will determine site-specific cover and habitat types and current conditions. Selection criteria for these types as spelled out in the condition-based management approach, will be used to prescribe the appropriate treatments.

Table 14. Condition-based Management Approach for Aquatics and Watershed Restoration Activities: Considerations for prioritizing aquatics and watershed restoration activities

Consideration	Description
Watershed Condition Framework and priority watersheds.	Areas or activities within existing Watershed Restoration Action Plans can increase opportunities to move watersheds into a higher condition class. Maintaining or improving watershed condition where feasible should be taken into consideration. Projects in priority watersheds should be considered.
Projects that improved impaired waters	Projects that improve water quality in ADEQ TMDL (water quality improvement plan) or 303b listed streams.
Vegetation restoration activities within the area.	Incorporating aquatic and watershed restoration activities in an area with other restoration treatments whenever possible is one way to create efficiencies with heavy equipment and personnel.
Partner Interest	Projects that already have partners or interested partners, particularly if funding is available, should be considered.
Benefits to federally listed or candidate species	The presence of these species and improving their habitat could increase the prioritization of a project over a site that had none present.
Wet meadows, cienegas, and other similar habitats.	These habitat types store water in upper watersheds and maintain baseflow to other aquatic habitats. They also cool water and can provide for lower stream water temperatures. Maintaining and improving these areas can have great downstream beneficial impacts.
Upper watershed vs. lower	Restoration in upper portions of watersheds can have beneficial impacts downstream such as reduced sedimentation, maintaining baseflow, and cooling stream temperatures. They will have a larger range of beneficial impacts than projects lower in a watershed.
Issues that are new, easily treated, or could quickly spread.	Newer issues have not yet caused that much damage; restoration treatments of these are more cost and time effective as well as preventing more degradation. Projects such as these are 'low-hanging fruit' when compared to larger or more widespread issues. In addition, new infestations of noxious weeds or aquatic invasive plants are easier to treat early rather than after they spread.
Force account, contracted, and partner implementation	All three categories have merit but may have differing financial or oversight costs. These should be considered differently amongst options and assessed. Prioritization may depend upon which category a project occurs in when weighed against workload, capacity, and financial considerations.
Process versus form-based projects	Projects that enhance site conditions, but do not restore the processes that create habitat or site conditions are considered form-based. These types of projects can require more maintenance than projects that restore the processes that create and maintain habitat. Projects that restore processes may be more of a priority than those that address a specific issue rather than the larger problem.

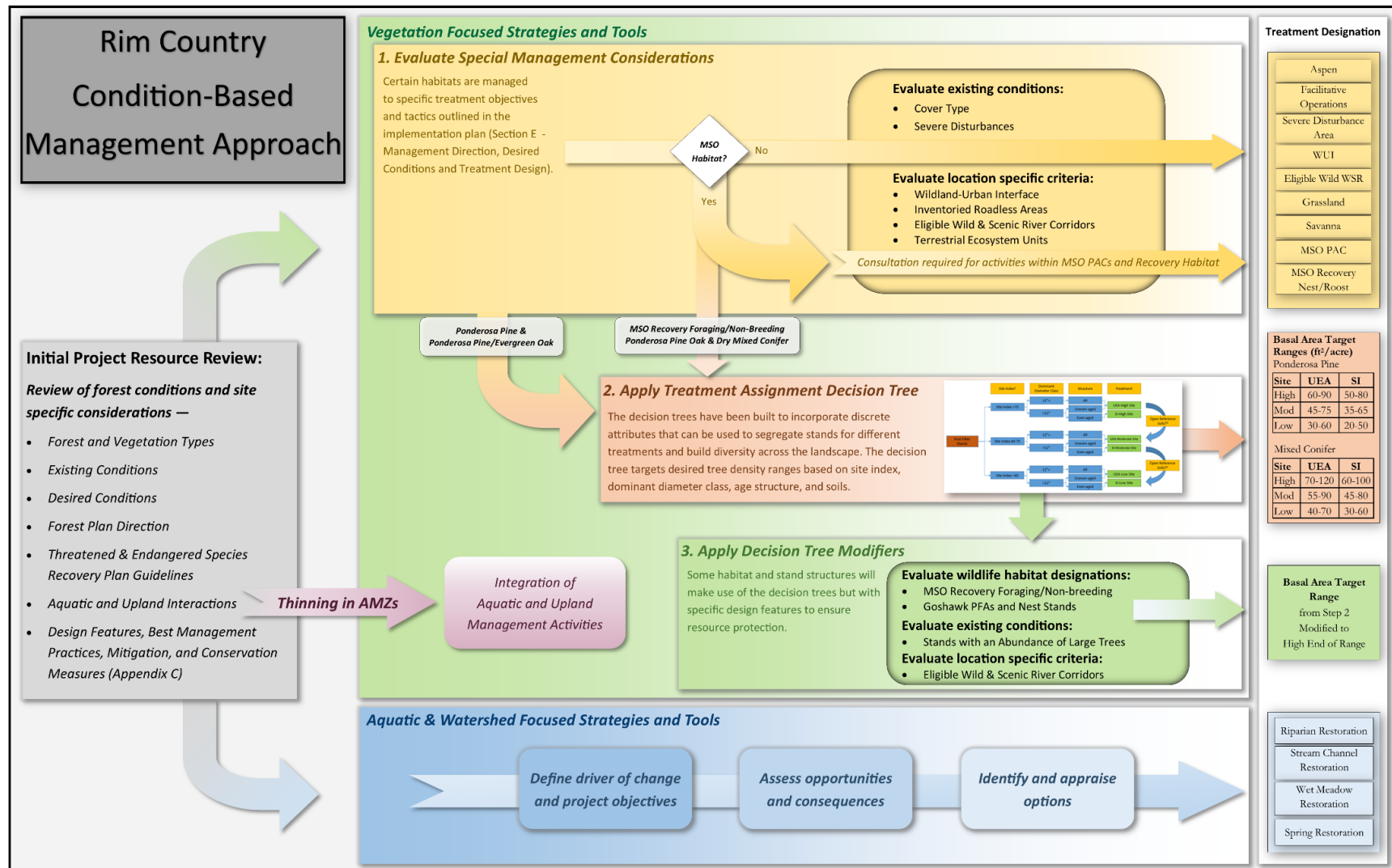


Figure 6. Condition-based management approach treatment assignment process

Monitoring Plan

Appendix E includes the Biophysical and Socioeconomic Monitoring and Adaptive Management Plan. This plan is designed to be integral to the selected alternative and record of decision. The monitoring plan details the framework and process for monitoring selected activities. The 4FRI Stakeholder Group and the Forest Service coordinated on the design of the monitoring plan.

Activities Common to Alternatives 2 and 3

Because they are guided by the same goals and objectives, all restoration approaches would entail some of the same activities. This section described the activities that are common between alternatives 2 and 3.

Treatment Descriptions

Vegetation treatments (mechanical thinning and prescribed burning), treatment descriptions, and treatment intensities are identical between the action alternatives however, acres of treatments are different between the action alternatives. Within the Alternative 2 – The Modified Proposed Action and Alternative 3 – Focused Restoration sections below, the acres for each treatment type are displayed.

Table 15 defines the different types of mechanical and prescribed fire treatments that would occur within the Rim Country Project area under both action alternatives and their objectives. Some treatments include both mechanical and prescribed fire treatments, while others only include mechanical or prescribed fire separately.

Mechanical thinning methods include conventional ground-based harvest, cable operations, and hand thinning. Conventional ground-based harvest systems typically consist of several machines that all perform specialized functions including feller-bunchers (wheeled and boomed), grapple skidder, processor, and loader. Cable operations is a system of transporting logs from stump to landing by means of suspended steel cables. This method is usually preferred on steep slopes where conventional ground-based harvesting cannot be carried out effectively. Cable operations generally reduce the need for the construction of temporary roads. Hand thinning typically consists of mechanical thinning performed with the use of hand tools, such as, but not limited to, chainsaws, trimmers, and loppers. Methods and equipment used would depend on the final decision, limitations from design features, and the contractor procured during implementation.

Prescribed fire is a planned ignition to meet specific objectives identified in a written and approved prescribed fire plan for which NEPA requirements (where applicable) have been met prior to ignition. Initial ignition would occur by hand-held, mechanical, or aerial devices.

Table 15. Alternatives 2 and 3 mechanical and prescribed fire treatment descriptions and objectives

Treatment Type	Treatment Description/Objective
Stand Improvement (SI)	Mechanical and prescribed fire treatments that thin generally young, even-aged stands. Establishes tree groups and interspace/openings adjacent to tree groups. Treatments are ecologically responsive with post-treatment basal area ranges lower on sites with low productivity, moderate on sites with moderate site productivity, and highest on sites with high site productivity. Manages for improved tree vigor and growth by retaining the best growing dominant and co-dominant trees within each group and as many old and/or large trees as possible, in accordance with the Old Tree Implementation Plan and Large Tree Implementation Plan and establishes non-forested grass/forb interspace/openings between residual tree groups or individual randomly spaced trees. Begins conversion to uneven-aged structure.
Uneven-aged (UEA)	Mechanical and prescribed fire treatments designed to develop uneven-aged structure and a mosaic of interspaces and tree groups of varying sizes. Thins tree groups to an average of 20 to 90 BA in pine cover types and 30 to 120 BA in dry mixed conifer cover type and establishes non-forested grass/forb interspace/openings between residual tree groups or individual randomly-spaced trees. Treatments are ecologically responsive with post-treatment basal area ranges lower on sites with low productivity, moderate on sites with moderate site productivity and highest on sites with high site productivity. Manages to enhance growing space for younger trees, while retaining as many old or large trees as possible, in accordance with the Old Tree Implementation Plan and Large Tree Implementation Plan. Establishes regeneration where seedlings and saplings are underrepresented. Locates interspace/openings in currently non-forested areas and lacking pre-settlement evidence.
Prescribed Fire Only (in and outside of PACs)	Prescribed burning to improve structure, maintain and develop large trees, and reduce risk of high-severity fire effects. Retain old growth attributes, protect large oaks, and ensure snags and coarse woody debris post-fire. Reduce conifer litter/duff at ground level to promote increased herbaceous species cover and species richness. Restore/regulate vegetation mosaics, including woody and herbaceous species.
Aspen Restoration (in and outside of PACs)	Mechanical treatments that removes post-settlement conifers within 66 feet (one chain) of the aspen clone. Managed to stimulate suckering by removing aspen, disturbing the ground, barrier construction, and/or applying fire as needed.
Facilitative Operations (FO) – Mechanical (in and outside of PACs)	Mechanical and prescribed fire treatments in non-target cover types to support the use of prescribed fire in cover types targeted for restoration. Includes mastication/chipping; lop and scatter; thinning/limbing; and moving, rearranging, or removal of jackpots or excessive surface fuels. Designed to improve safety, improve treatment effectiveness, expand burn windows, decrease undesirable fire behavior and effects, and minimize disturbance from fireline construction.
Facilitative Operations (FO) – Prescribed Fire Only (in and outside of PACs)	Prescribed fire treatment in non-target cover types to support the use of prescribed fire in cover types targeted for restoration. Includes broadcast burning, jackpotting, pile burning, and blacklining. Designed to improve safety, improve treatment effectiveness, expand burn windows, decrease undesirable fire behavior and effects, and minimize disturbance from fireline construction.
MSO Recovery – Replacement Nest/Roost	Mechanical and prescribed fire treatments designed to develop uneven-aged structure, irregular tree spacing, and a mosaic of interspace and tree groups of varying size. Intent is to continue to develop replacement Nest/Roost where possible, and to develop a diverse mix of heterogeneous stand structures and densities to provide for owl dispersal and foraging.
MSO PAC Mechanical	Mechanical and prescribed fire treatments outside core areas that thins to improve structure, maintain and develop large trees, and reduce hazard of high-severity fire in PACs. Designed to increase tree vigor and health, to promote irregular tree spacing, and to create canopy gaps more conducive to fire treatment (reduce fire risk). Retain old growth attributes, protect large oaks, and ensure snags and coarse woody debris post-treatment.

Treatment Type	Treatment Description/Objective
MSO PAC Hand Thin	Hand thinning and prescribed fire treatments outside core areas that thins to improve structure, maintain and develop large trees, and reduce hazard of high-severity fire in PACs. Designed to increase tree vigor and health, to promote irregular tree spacing, and to create canopy gaps more conducive to fire treatment (reduce fire risk). Retain old growth attributes, protect large oaks, and ensure snags and coarse woody debris post-treatment.
Savanna Restoration (70 to 90 percent openness)	Mechanical and prescribed fire treatments that restore pre-settlement tree density and pattern by removing encroaching post-settlement conifers. Manages for a range of 70 to 90 percent openness (10 to 30 percent woody canopy cover) using pre-settlement tree evidence as guidance. Retains all pre-settlement trees and the largest post-settlement trees as replacement trees adjacent to pre-settlement tree evidence (stumps, dead and down).
Severe Disturbance Area Treatment (in and outside of PACs)	Combination of restoration treatments: reforestation, prescribed fire, lopping/scattering, mastication, and other mechanical methods. Objective is to restore the fuel structure that produces the types of fire to which fire adapted ecosystems are dependent and put stands on a trajectory toward the natural range of variability.
Wildland Urban Interface and Infrastructure Protection	Mechanical treatments that allow maintenance of a more open structure and/or lower fuel load than elsewhere in the project area resulting in post-treatment stand densities between 30-60 square feet/acre, within a ½-mile buffer surrounding critical infrastructure (transmission lines and communication sites) and high value Forest Service infrastructure (buildings and recreation sites), and around non-Forest System lands where structures are present. Treatments are designed to: reduce fire transmission to and from communities, improve firefighter safety and effectiveness, increase evacuation time in emergencies, reduce ember production, increase decision space for fire managers, and allow for more frequent prescribed fires.
Grassland Restoration	Mechanical and prescribed fire treatments to reduce or eliminate woody species encroachment (pines, junipers and various shrubs). Remove trees established since interruption of the historic fire regime. Promote and re-establish the historic meadow edge. Reestablishment of a frequent fire regime will play a prominent role in reducing conifer encroachment in the future. Retain all pre-settlement trees and leave replacement trees where evidence of historical large trees exist.
Wet Meadow Restoration	Mechanical and prescribed fire treatments to reduce or eliminate woody species encroachment (pines, junipers and various shrubs). Remove trees established since interruption of the historic fire regime. Promote and re-establish the historic meadow edge. Improvement in hydric "wet" characteristics of the soil will play a prominent role in reducing conifer encroachment in the future. Retain all pre-settlement trees and leave replacement trees where evidence of historical large trees exist.
Riparian Restoration	Combination of restoration treatments, including mechanical and prescribed fire treatments to maintain riparian vegetation and habitat. Remove encroaching upland tree and shrub species. Promote, protect, or plant native aquatic or riparian species. Prescribed fire to regenerate riparian species and reduce fuels accumulation.

PACs – protected activity centers

Facilitative Operations

The facilitative operations treatment description is identical between the action alternatives however, acres of treatments are different between the action alternatives. Within the Alternative 2 – The Modified Proposed Action and Alternative 3 – Focused Restoration sections below, the acres for each treatment type are displayed.

Facilitative operations are vegetation treatments proposed in non-target ecological response unit cover types to support the use of prescribed fire in target ecological response unit cover types. Mechanical treatments in facilitative operations would be designed to reduce the potential of high intensity fire behavior in prescribed burn units that contain non-target ecological response unit cover types and are adjacent to or between target ecological response unit cover types. The treatments would either move these non-target cover types toward land management plan desired conditions or maintain their current condition while remaining consistent with the land management plan. The treatments would use prescribed burning, or a combination of mechanical fuel reduction followed by prescribed burning.

Mechanical fuel reduction would be used in areas where prescribed burning alone would produce too much fire behavior intensity that would be unsafe to fire personnel, increase the risk of prescribed burns escaping containment boundaries, and/or cause unacceptable damage to ecosystems including vegetation, wildlife, soils and water resources. The use of mechanical treatments would be condition based and only used in problematic fuels that need to be reduced prior to prescribed burning.

The use of facilitative operations would:

1. Improve safety by expanding burn units to existing natural or human-made features that could serve as effective firelines such as roads, trails, cliffs, ridges, dams, pits, rock, water, and powerline corridors. This would reduce fire personnel exposure to risks encountered during fire line construction. These existing barriers are usually more effective than a fire line made by fire personnel and heavy machinery, or can be made so with less risk, less time, less effort, and lower costs.
2. Improve treatment effectiveness and the timeframes for which prescribed fire treatments can be applied.
3. Under some conditions, heavy fuel loading in chaparral or dense pinyon/juniper (particularly with a significant dead component) has the potential to produce unacceptably high fire behavior, spotting, or other undesirable fire behavior. Where these kinds of fuels exist between target cover types and logical fuel breaks, undesirable fire behavior and effects could be decreased by manipulating fuel loading and structure. This would allow prescribed fire to be implemented under a broader range of conditions, while producing the desired fire effects.
4. Minimize the disturbance associated with fire line construction, such as soil disturbance, branch breakage, or bole damage caused by bulldozers, ATV draglines, handlines, and other means. Using existing features would result in less disturbance than other methods of creating a functional burn unit.

Types of Facilitative Operation Treatments

The expectation is that most facilitative operations treatments would be only prescribed fire with no mechanical treatments and mechanical facilitative operations treatments would be the exception.

Fire

All areas proposed for facilitative operations would be available for prescribed fire, including:

- Broadcast/underburning
- Jackpotting (process of adding to and igniting small accumulations of woody debris)
- Pile burning
- Blacklining

Mechanical

Where mechanical facilitative operations treatments are needed, they would be site-specific and consider the requirements for all resources. Mechanical treatments could be combined with prescribed fire include:

- Mastication/chipping
- Lop and scatter
- Thinning/limbing
- Moving, rearranging, or removal of jackpots or excessive surface fuels by hand crews or using mechanical equipment

- Any combination of the above

Outside of protected activity center's facilitative operations mechanical treatments would thin trees 0-18" diameter at breast height from below to a residual canopy cover of 30 percent. In protected activity center's facilitative operations mechanical treatments would use the uneven-aged BDq³ method where B=55 feet squared, D=0-18 and Q=1.1, retention of 99 legacy trees/acre.

Table 16 shows the acreages of facilitative operations non-target ecological response unit cover types for alternative 2 and 3 and broken down by mechanical treatment followed by prescribed burning and prescribed burning only.

Table 16. Proposed facilitative operations treatment by existing forest type

Proposed Treatment by Existing Forest Type	Alt2	Alt3
Facilitative Operations Mechanical/Prescribed Burning	121,610	46,828
Grassland/Meadow ¹	3,252	245
Madrean Encinal Woodland	1,689	1,663
Madrean Pinyon-Oak	18,542	11,443
Mixed Conifer with Aspen	2,136	2,000
Pinyon-Juniper Woodland	94,608	30,958
Other (Dam/Pit/Road/Rock/Water)	1,384	519
Facilitative Operations Prescribed Burning Only	11,835	4,062
Grassland/Meadow	222	23
Madrean Pinyon-Oak	1,347	544
Mixed Conifer with Aspen	2,519	480
Pinyon-Juniper Woodland	7,435	3,009
Other (Dam/Pit/Road/Rock/Water)	312	6
Grand Total	133,445	50,891

¹Existing grasslands and meadows that do not coincide with grassland and wet meadow restoration treatments due to the scale of terrestrial ecosystem unit mapping.

Figure 7 shows an idealized landscape in which the existing features that would make an effective fireline are some cliffs, two Forest Service roads, a highway, and a trail. In this case, all of the burn units that could be outlined with these features would include pinyon/juniper. Excluding pinyon/juniper from a burn unit would require a fireline. If the pinyon/juniper was included in the burn units, the need for ground disturbing activities would be minimized, and decrease the risk of injury for fire managers building firelines.

In this case, the use of facilitative operations would allow the inclusion of the pinyon/juniper area between the ponderosa pine and the road to be included in the prescribed burn unit, as shown in figure 7. Fire managers would identify areas where there would be a potential need for mechanical treatments, and work with other resource specialists to identify the appropriate mechanical treatments.

³ BDq is an acronym which represents target basal area (B), maximum diameter at breast height (D), and diminution quotient squared (q, the tree-frequency ratio between successive diameter classes). These three components together characterize a target structure for a stand.

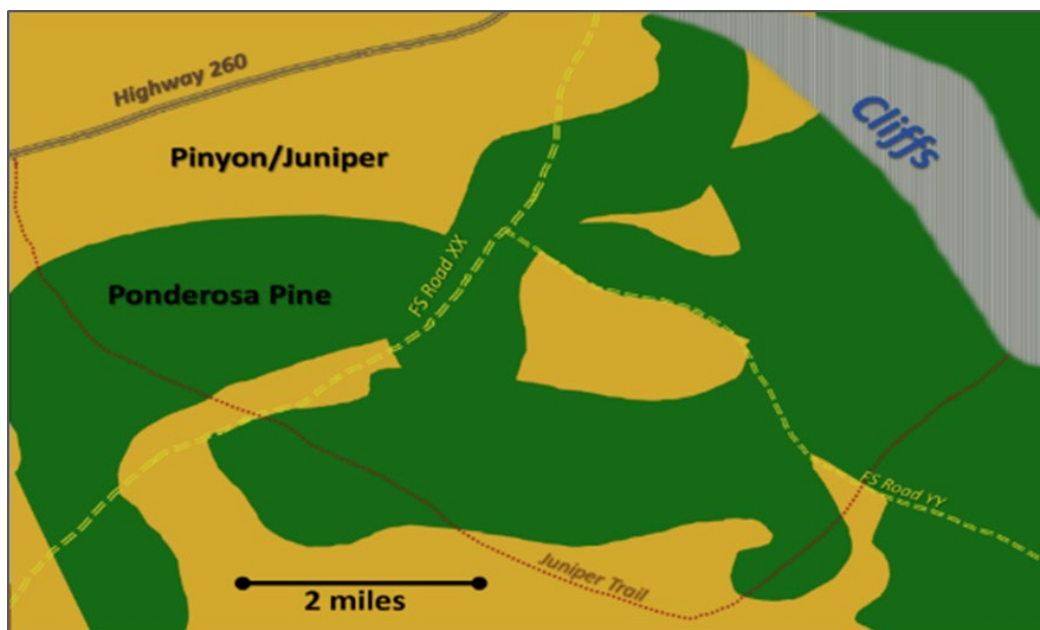


Figure 7. Idealized landscape of target and non-target cover types and fireline features

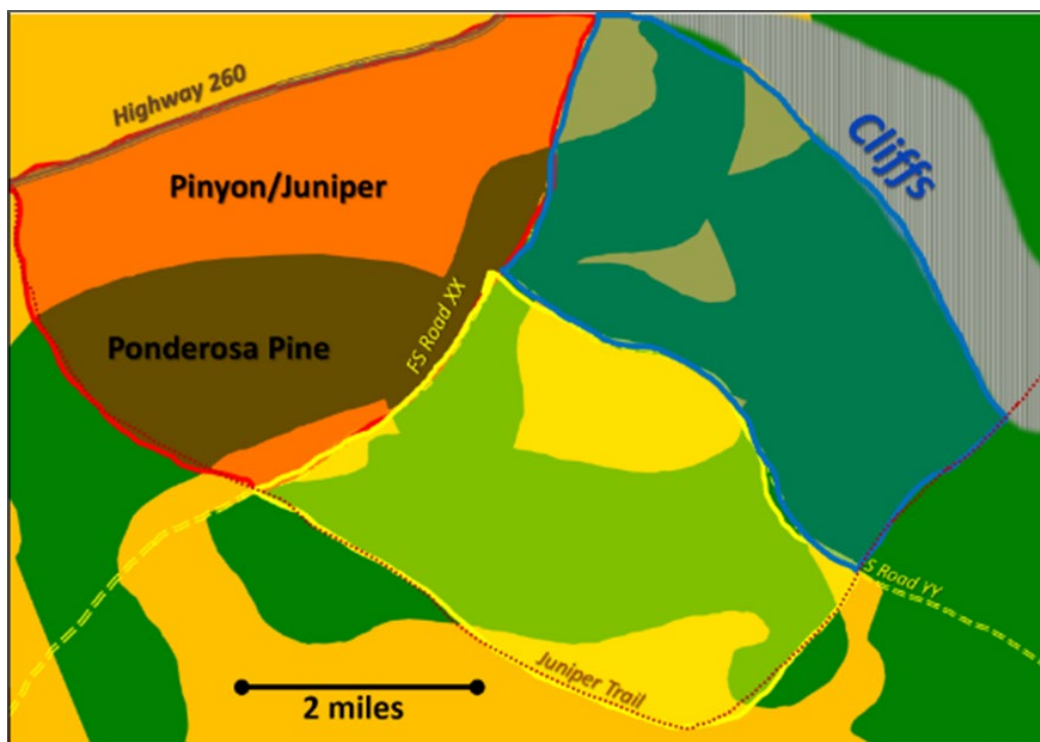


Figure 8. Same landscape with three burn units

Severe Disturbance Area Treatments

The severe disturbance area treatment description is identical between the action alternatives however, acres of treatments are different between the action alternatives. Within the Alternative 2 – The Modified Proposed Action and Alternative 3 – Focused Restoration sections below, the acres for each treatment type are displayed.

Severe disturbance areas are those where the spatial extent or the pattern of high-severity fire effects is not within natural range of variation. In some places this has resulted in aggressively sprouting species, such as alligator juniper and various species of oak dominating the vegetative response, making it difficult or impossible for ponderosa pine to establish or thrive. In other areas, extensive, overly dense patches of ponderosa pine regeneration have put stands on a trajectory toward stagnation, density-related mortality, or additional severe disturbance. Appendix D contains additional information on severe disturbance area treatment implementation. Some severe disturbance areas are known, and examples are listed below however, treatment could be applied as needed based on conditions at the time of implementation see appendix D). In this acreage for Rim Country are:

- Bray Fire (Coconino, Tonto)
- Breed Fire (Apache-Sitgreaves)
- Coon Fire (Tonto)
- Crossing Fire (Apache-Sitgreaves)
- Dude Fire (Apache-Sitgreaves, Coconino, Tonto)
- Durfee Fire (Apache-Sitgreaves)
- February Fire (Tonto)
- Five Mile Fire (Coconino, Tonto)
- Juniper Fire (Tonto)
- Mistake Peak Fire (Tonto)
- Packrat Fire (Coconino, Tonto)
- Picture Fire (Tonto)
- Pot Fire (Coconino)
- Potato Fire (Apache-Sitgreaves)
- Promontory Fire (Tonto)
- Rodeo-Chediski Fire (Apache-Sitgreaves, Tonto)
- Rim Fire (Tonto)
- Slim Fire (Apache-Sitgreaves)
- Tanner Fire (Tonto)
- Webber Fire (Tonto)
- Tinder Fire (Coconino)
- Pivot Rock Fire (Coconino)

Restoration treatments in severe disturbance areas would include combinations of reforestation, prescribed fire, lopping/scattering, mastication, and other mechanical methods with the objective of identifying treatments that would be effective in restoring the fuel structure that produces the types of fire to which ponderosa pine is dependent. In areas of extensive, pure ponderosa pine regeneration, the decision tree in the condition-based management approach for mechanical treatments will be applied.

Comprehensive Restoration

The two action alternatives include the same amount of comprehensive restoration activities throughout the project area. This section provides a description and the acres/miles/amount of comprehensive restoration activities that would occur under both alternatives 2 and 3.

The overall goal of 4FRI is landscape-scale restoration that provides for fuels reduction, forest health, and wildlife and plant diversity. All kinds of restoration work, in addition to thinning and prescribed burning, are proposed in the Rim Country Project. For the Rim Country Project, restoration treatments that are designed to complement upland forest thinning and prescribed burning restoration treatments are called comprehensive restoration treatments. These treatments are proposed in order to restore and improve habitat for aquatic and terrestrial wildlife and rare plants. Comprehensive restoration activities include restoring grasslands, riparian areas, meadows, springs, and streams; road decommissioning and relocation; and construction of barriers to protect sensitive areas and species from grazing. The

condition-based management for aquatic and watershed restoration activities (see appendix D of the FEIS) would be used to implement most of these restoration activities.

In areas already covered by NEPA decisions (See the Areas Covered Under NEPA Decisions For Inclusion of Restoration Activities section and figure 5), comprehensive restoration activities such as spring and stream channel restoration and road decommissioning are proposed to complement the activities already analyzed in the project areas. The acres of comprehensive restoration treatments in areas covered by NEPA decisions are the same under both alternatives 2 and 3 and incorporated into the figures shown below.

Proposed Activities Common to Both Alternative 2 and 3

- Restore approximately 184 springs.
- Restore function and habitat on up to 647 miles of streams, including stream reaches with habitat for threatened, endangered, and sensitive aquatic species. Heavy mechanical stream restoration activities could be used on 402 miles of the 647 miles.
- Decommission up to 200 miles of existing system roads on the Apache-Sitgreaves and Coconino National Forests, and up to 290 miles on the Tonto National Forest.
- Decommission up to 800 miles of unauthorized roads on the Apache-Sitgreaves, Coconino, and Tonto National Forests.
- Relocate and reconstruct existing open roads adversely affecting water quality and natural resources, or of concern to human safety.
- Construct up to 200 miles of protective barriers around springs, aspen, native willows, and big-tooth maples, as needed for restoration.
- Restore approximately 36,330 acres of grassland, including maintaining or restoring montane meadow connectivity in pronghorn corridors.
- Restore hydrologic function and vegetation on approximately 6,720 acres of meadows.
- Restore approximately 14,570 acres of riparian areas for aquatic stream habitat.

Table 17. Alternatives 2 and 3 grassland, wet meadow, and riparian restoration treatment acres

Treatment Type	Grassland Restoration Treatment (acres)	Wet Meadow Restoration (acres)	Riparian Restoration (acres)
Mechanical and Prescribed Fire	36,290	6,410	12,790
Prescribed Fire Only	40	310	1,780
Total treatment	36,330	6,720	14,570

Spring Restoration

Specific treatments to restore springs would be identified prior to mechanical and prescribed fire treatments in the vicinity, using the Condition-based Management Approach for Aquatic and Watershed Restoration Activities (see appendix D). Treatments could include removing the tree canopy close to the spring, applying prescribed fire, re-plumbing the spring improvements to conserve water, protecting the spring with fencing, and removing or relocating adjacent roads or trails.

Stream Restoration

Specific treatments to restore riparian streams and stream channels and their function would likely be identified prior to mechanical and fire treatments in the vicinity, using the Condition-based Management Approach for Aquatic and Watershed Restoration Activities (see appendix D). General stream treatments include methods that could either be implemented by hand or using equipment like a pneumatic post pounder or gas-powered auger. Heavy mechanical treatments are those that require machinery such as a trackhoe or front-end loader. Treatments could include reestablishing former drainage patterns, stabilizing slopes, restoring vegetation, protecting sites from grazing ungulates, removal of upland species that compete with riparian species, returning fire to the system (prescribed fire), and/or removing stock tanks. The emphasis will be on non-structural rather than structural methods. Figure 9 displays the locations of stream restoration activities for both alternatives 2 and 3.

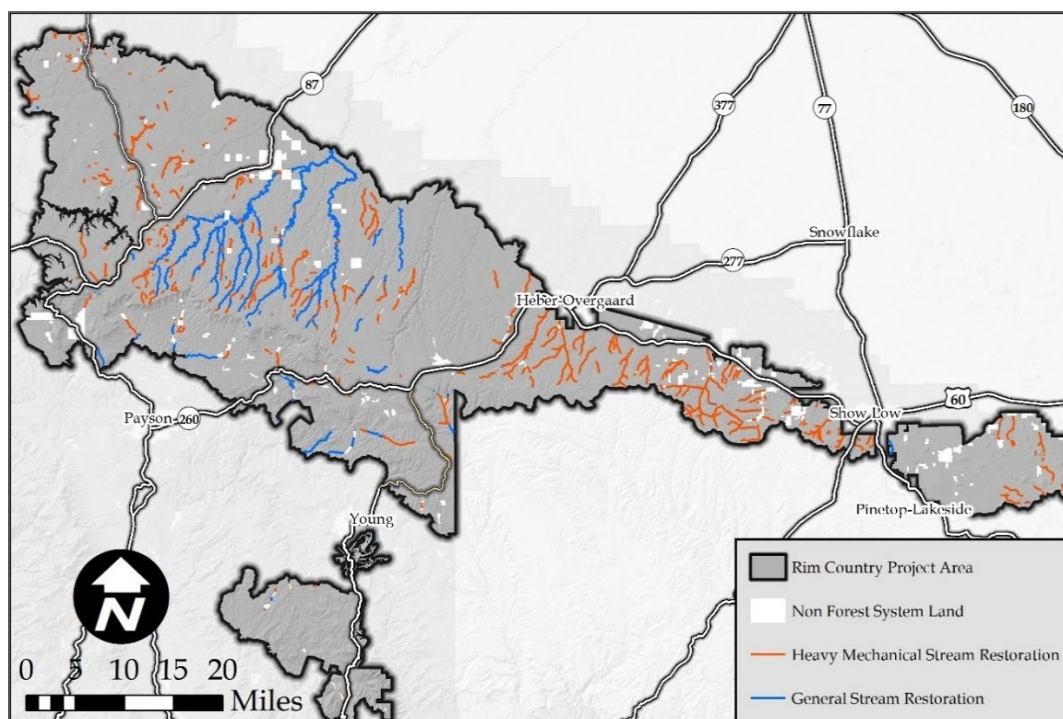


Figure 9. Alternatives 2 and 3 stream restoration activities

Riparian Habitat Restoration

Proposed stream habitat treatments may be needed within all or some portion of fish-bearing streams. Specific treatments to restore riparian streams and stream channels and their function would likely be identified prior to mechanical and fire treatments in the vicinity, using the Condition-based management approach for aquatic and watershed restoration activities (see appendix D). Restoration treatments may include channel restoration (one rock dams, grade control, or induced meandering) and channel structural improvements (felling or girdling trees to provide large woody debris for cover and habitat complexity). Figure 10 displays the locations of riparian habitat restoration activities for both alternatives 2 and 3.

Grassland and Meadow Restoration

Proposed mechanical vegetation treatments to remove conifer encroachment. Methods include ground-based logging systems and hand thinning to restore and sustain grassland and meadow habitat types.

Figure 10 displays the locations of grassland and meadow restoration activities for both alternatives 2 and 3.

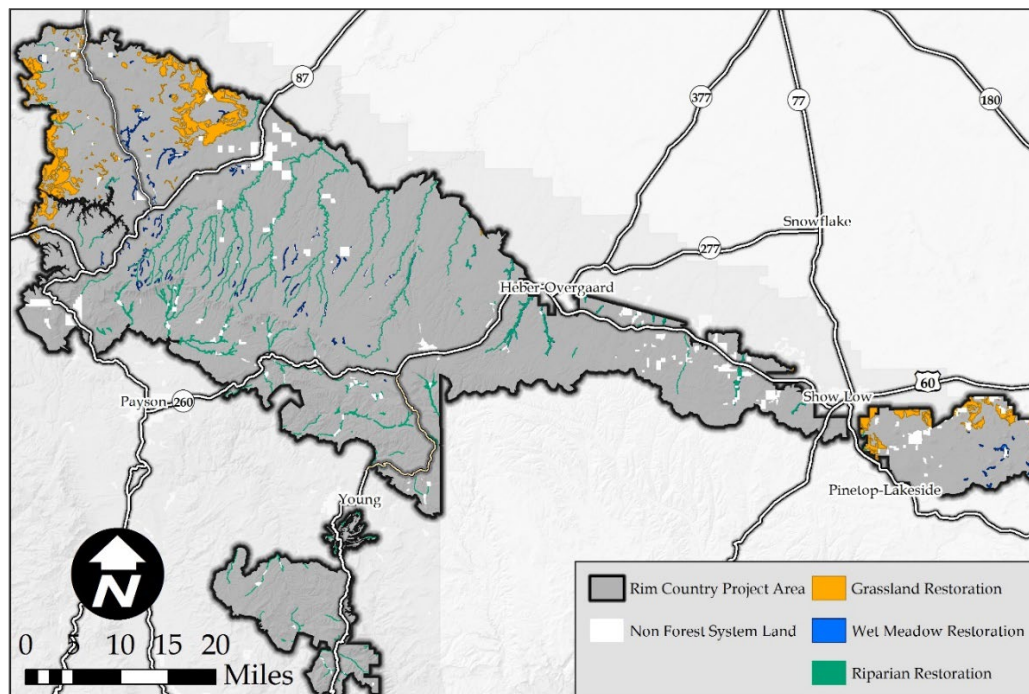


Figure 10. Alternatives 2 and 3 grassland, meadow, and riparian restoration activities

Road and Trail Relocation/Reconstruction/Decommission

Specific treatments for roads, trails, and unauthorized routes that are affecting water resources would be evaluated prior to mechanical and fire treatments in the vicinity, using the Condition-based Management Approach for Aquatic and Watershed Restoration Activities (see appendix D). Generally, routes crossing and those within 300 feet of streams and waterbodies are the highest priority for evaluation and treatment. Treatments could include adding gravel to the road surface of existing authorized routes, stabilizing slopes, and restoring vegetation; closing roads, trails, or unauthorized routes by blocking the entrance or installing water bars; removing culverts, reestablishing drainages, removing unstable fills, pulling back road shoulders, and scattering slash on the roadbed; and obliterating the roadbed by restoring natural contours and slopes.

Specific treatments for improving stream crossings that are affecting water resources would be evaluated prior to mechanical and fire treatments in the vicinity. Treatments could include: armoring downstream outlets of culverts, upsizing existing culverts, installing culverts or additional culverts, installing culvert arrays to mimic existing channel width, installing low water crossings, installing bridges, restoring downstream channels created from crossings, using sediment reduction methods on connected disturbed areas upstream from roads that connect to the drainage, paving crossings, and relocating the segment of the road that has the crossing issue out of the stream.

Road decommissioning activities result in the stabilization and restoration of unneeded roads or trails to a more natural state. The road or trail is permanently removed from the transportation system. The activities range from blocking the entrance, scattering boughs on the roadbed, revegetating and water barring, to removing fills and culverts, reestablishing drainage-ways, pulling back shoulders, and recontouring the slopes for full obliteration.

In-woods Processing and Storage Sites (Processing Sites)

The distance of the western part of the Rim Country project area from businesses that can process wood products from mechanical thinning prompted the identification of potential processing sites for use as needed by contractors during implementation.

In-wood processing sites would facilitate more use of forest resources, increase transportation efficiencies, reduce implementation costs, and generally make it easier to complete implementation.

Processing sites serve many purposes. Some log sorting would be done on all processing sites, for various reasons such as increased log value and decreased hauling cost, taking advantage of available log markets, and providing a better log mix to consuming mills. Concentration log yards would provide a central point for accumulating logs for drying, debarking, and processing, and later shipment to mill yards. Small diameter timber or residue from log processing may be chipped and hauled to mills or other businesses. The advantage of having strategically located processing sites over sorting logs at a landing is that logs can be more easily moved, bucked, and sorted by quality characteristics (species, size, and grade) for allocation to their highest values use (Dramm et al. 2002).

Twelve new in-woods processing sites are proposed for use in the Rim Country EIS (table 19). The identification of potential processing sites was initially done using spatial analysis techniques and followed up with on-the-ground validation and input from subject matter experts. Variables such as current road system, slopes and landforms, economics of transportation, recreation sites, visual aesthetics, and wildlife and hydrological concerns were factored into the analysis process. Project design features (appendix C) also apply to in-woods processing sites. The 12 sites and their estimated size analyzed in this EIS are shown in table 19 and figure 11.

Eight processing sites were proposed and analyzed for environmental effects in the Cragin Watershed Protection Project (CWPP) (USDA FS, 2018b) (table 18). These sites are carried forward for potential use in implementing the Rim Country Project. Figure 11 displays the processing sites already analyzed in the CWPP Environmental Analysis and the additional sites being analyzed in this EIS.

In total, the 20 in-woods processing and storage sites may be used for implementation of the Rim Country Project over its implementation period for 20 years, or until implementation is completed. Continuous-use processing sites are those where use is expected to be continuous on a regular basis for 10 to 20 years. These sites are typically the larger 10- to 21-acre areas located close to major highways. Sites originally developed and operated for continuous use will frequently change to intermittent use or occasional use following initial harvest activities in the area. Intermittent use processing sites are those where use is expected to be shorter term and used for one or multiple contract periods, lasting from 3 to 10 years.

Table 18. Processing sites analyzed in Cragin Watershed Protection Project

Site Name	Acres
FR 141, 9398	5
FR 147, 6096/6097	5
211 Revised	15
613F	15
9033H	15
FR 95, North 9032C	10
FR 95F/396	9
9729A	5
Total (8)	79

Table 19. Processing sites analyzed in 4FRI Rim Country

Site Name	Acres
FR 117, 1321	4
FR 139, 9729D	14
FR 145A, 9615X	7
FR 288, 2781	4
FR 294, 294D	18
3238, 512	20
FR 582, Hwy 87	5
FR 609, 1938	7
FR 74, 64	8
FR 81, 81E	7
9364L, FH 3	21
9731G, Hwy 87	9
Total (12)	128

Tasks done by equipment at processing sites would include, but is not limited to, drying, debarking, chipping stems and bark, cutting logs, manufacturing and sorting logs to size, producing wood cants,⁴ scaling and weighing logs, and creating poles from suitable sized logs. Equipment commonly used at processing sites would include circular or band saws, various sizes and types of front-end loaders, log loaders, and several types of chippers. Equipment may include timber processors, planers and mechanized cut to length systems, associated conveyers, and log sorting bunks for accumulation and storage of logs. Electric motors and gas or diesel generators would also be used to provide power. Large processing sites, 10 or more acres in size, would allow for more flexibility in their design and allow for more area to process, grade, scale and sort logs, and manufacture cants, poles, and chip and haul products. Larger sites would handle surges in incoming logs and would protect workers better by providing better separation between processing and transport functions. Medium-sized processing sites, five to 10 acres in size, would allow log processing equipment use with more limited storage (Dramm et

⁴ A cant is a piece of wood usually over 2 inches thick and sawn flat on one to three sides. Most pallet shops want cants to re-saw into pallet parts because they have more options on what sizes they can cut from them.

al. 2002). Landings for mechanical thinning contracts would be considerably smaller than log sort yards, typically about 1/3 of an acre. Processing sites may be authorized under timber contract or under special use authorizations. Special use authorizations for processing sites would comply with appropriate policies related to cost recovery and land use fees and other special use regulations (36 CFR 251). After use is complete, in-woods processing sites would be rehabilitated in accordance with project design features including restoring proper drainage and reseeding as needed with native species. A performance bond would be used to ensure that all obligations are fulfilled by the contractor or permittee and would be used if needed to cleanup and rehabilitate the processing sites.

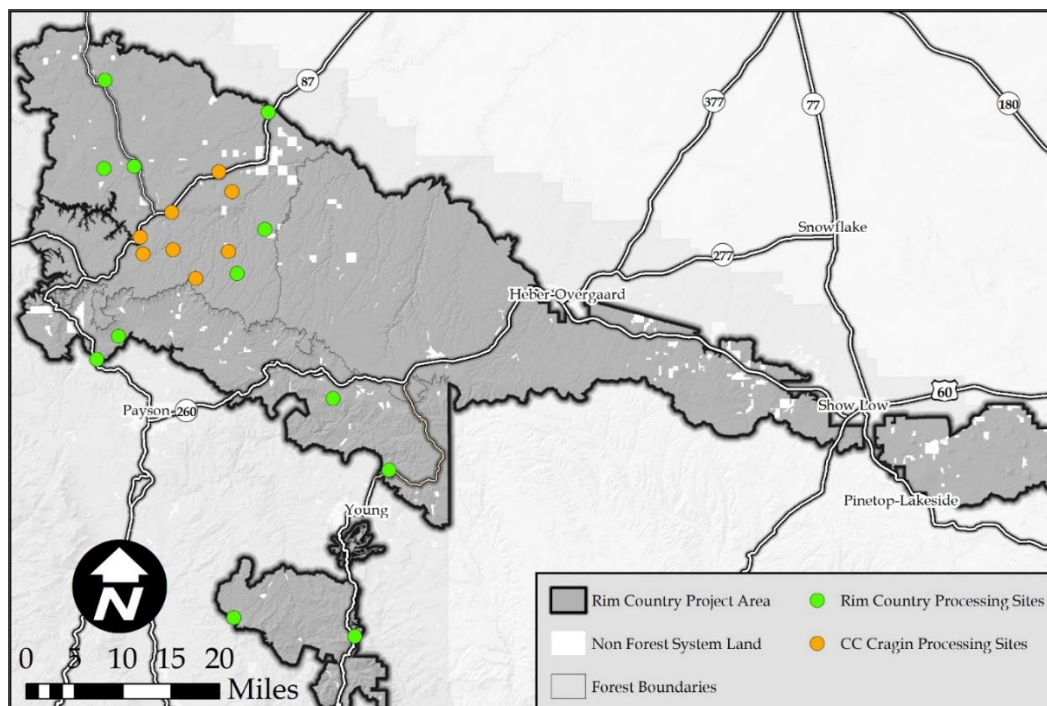


Figure 11. Proposed in-woods processing sites

Rock Pit Expansion and Use

Rim Country Rock Pit Expansion: On Apache-Sitgreaves National Forests, Black Mesa Ranger District, 11 existing rock pits in the Rim Country project area are proposed for a 30 percent expansion of their current footprint to provide future material for implementation of Rim Country (table 20). The potential environmental effects from the anticipated expansion of these rock pits, as well as those from their use, are analyzed in the Rim Country EIS.

Rock Pit Use: The Rim Country Project analyzes the effects from hauling rock from 10 rock pits in the Coconino National Forest (figure 12). On the Coconino National Forest, the development, expansion, and use of nine rock pits in the Rim Country project area was analyzed in the Rock Pits Environmental Assessment for the Coconino and Kaibab National Forests (June 2016). One additional rock pit, Park Knoll, is currently being developed by Coconino County and under contract. The Forest Service will have a reserve of approximately 20,000 cubic yards of material in this pit, so the potential effects from the use of this rock pit will be analyzed in the Rim Country EIS.

Table 20. Apache-Sitgreaves, Black Mesa Ranger District rock pit expansion

Pit Name	Current Acreage	Possible Increase in Acreage	Possible Future Total Acreage	Maximum Expansion in Feet from Existing Pit
34T	14	4	18	500
213	7	2	9	500
Pias Farm	6	2	8	500
115	7	2	9	500
717E	2	1	3	400
34B	2	1	4	500
Promontory	16	5	21	700
Carr Lake	12	4	16	600
Brookbank	1	1	2	400
Borrow	12	4	16	600
Cottonwoods Wash	6	2	8	500
Total	85	28	114	N/A

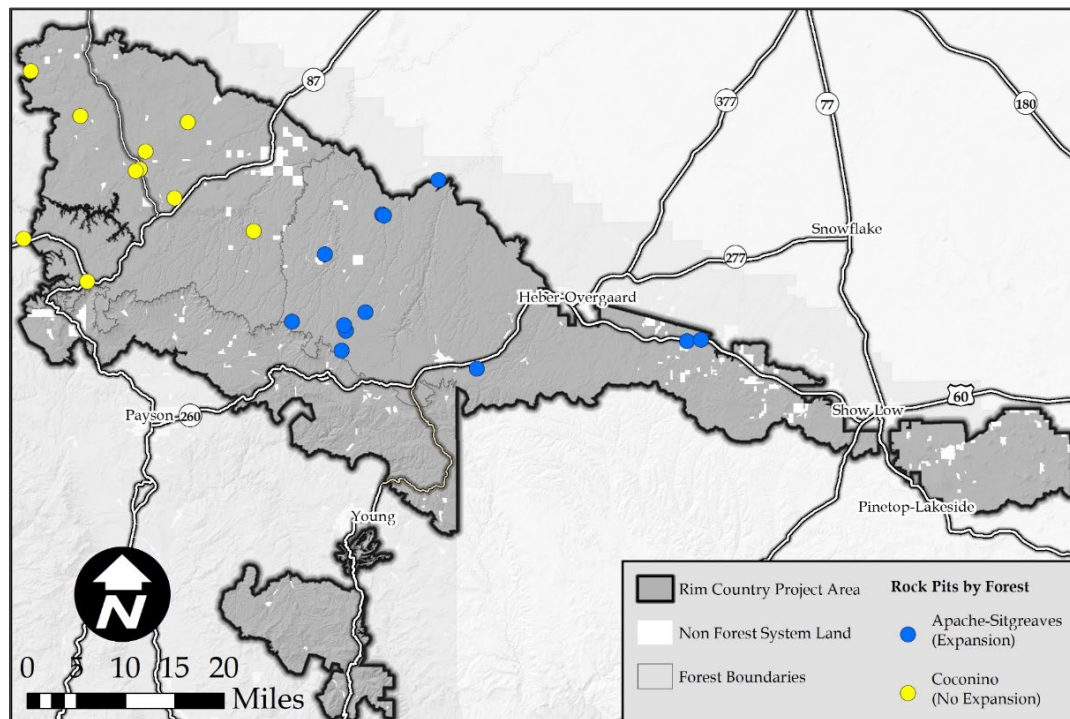


Figure 12. Apache-Sitgreaves and Coconino and National Forests rock pits

Alternative 2 – The Modified Proposed Action

Alternative 2 (the preferred alternative) is the Modified Proposed Action as presented for scoping, and includes additional detail, clarifications, corrections in response to public comments received from the scoping and the DEIS comment periods.

Restoration activities and treatments included in alternative 2 would maintain or restore forest structure and pattern, desired fire regimes, and watershed and ecosystem health and function in ponderosa pine, ponderosa pine-evergreen oak, frequent fire mixed conifer (dry mixed conifer), aspen, and grassland cover types, moving them toward conditions within the natural range of variation. Alternative 2 restoration activities and treatments are designed to achieve the purpose and need over a period of 20 years or until completed. Alternative 2 responds to the treatments in Mexican spotted owl protected activity centers, treatments in northern goshawk habitat, large tree retention, and economics issues.

This alternative, as modified, includes mechanical thinning and prescribed burning restoration treatments and also includes comprehensive restoration treatments, in-woods processing sites, and expansion of existing rock pits that are common between the action alternatives. See the Elements and Activities Common to Alternatives 2 and 3 section for elements and activities that are common between the two action alternatives.

In areas already covered by NEPA decisions (see the Areas Covered Under NEPA Decisions For Inclusion of Restoration Activities section and figure 5), comprehensive restoration activities would occur as outlined in the Elements and Activities Common to Alternatives 2 and 3 section above. Prescribed fire is specifically proposed under this alternative within Mexican spotted owl core areas within the Clints Well project area and within specific Mexican spotted owl protected activity centers in the Upper Beaver Creek project area.

Additional changes made to alternative 2 in response to public comment on the DEIS are detailed in the Changes from DEIS to FEIS section in chapter 1 and the Alternative Development section above.

Proposed Activities

Proposed activities for alternative 2 include:

Mechanically thin trees and/or implement prescribed fire on up to 991,060 acres. The following activities are called out to identify treatments of interest (note that some treatment acres have overlap):

- Implement mechanical thinning and prescribed fire on approximately 446,020 acres including:
 - Approximately 89,880 acres of stand improvement
 - Approximately 356,130 acres of uneven-aged thinning
- Implement prescribed fire alone on approximately 103,950 acres in target vegetation cover types
- Implement approximately 7,300 acres of mechanical treatment and prescribed fire and approximately 9,600 acres of prescribed fire only in eight IRAs (See Chapter 3, IRA section for information on treatments by IRA).
- Mechanically thin and/or implement prescribed fire on approximately 96,890 acres (in target and non-target vegetation cover types) of Mexican spotted owl protected activity centers including:
 - Approximately 13,450 acres of mechanical thinning and prescribed fire
 - Approximately 1,190 acres of hand thinning and prescribed fire

- Approximately 82,250 acres of prescribed fire only
- Mechanically thin and/or implement prescribed fire on approximately 169,440 acres of Mexican spotted owl recovery habitat including:
 - Approximately 25,450 acres of mechanical thinning and prescribed fire in Mexican spotted owl replacement nest/roost recovery habitat.
 - Approximately 2,830 acres of prescribed fire only in Mexican spotted owl replacement nest/roost recovery habitat.
 - Approximately 133,630 acres of mechanical thinning and prescribed fire in Mexican spotted owl foraging /non-breeding recovery habitat.
 - Approximately 7,540 acres of prescribed fire only in Mexican spotted owl foraging /non-breeding recovery habitat.
- Conduct facilitative operations in non-target cover types to support treatments in target cover types, including:
 - Approximately 121,470 acres of facilitative thinning and prescribed fire outside of protected activity centers
 - Approximately 3,070 acres of facilitative prescribed fire only outside of protected activity centers
 - Approximately 140 acres of facilitative thinning and prescribed fire in protected activity centers
 - Approximately 8,760 acres of facilitative prescribed fire only in protected activity centers
- Restore aspen on approximately 1,200 acres.
- Restore approximately 135,360 acres that have experienced severe disturbance, including about 130 acres in protected activity centers.
- Restore approximately 18,570 acres of savanna.
- Conduct wildland urban interface and infrastructure protection treatments on approximately 62,690 acres of forest system lands within a ½ mile of non-Forest System lands with structures and critical infrastructure
- Construct or improve approximately 330 miles of temporary roads (new and/or occurring on existing unauthorized roads) to facilitate mechanical treatments; decommission all temporary roads when restoration treatments are completed.

Table 21. Alternative 2 mechanical and prescribed fire treatment categories and acres

Treatment Type	Acres
Stand Improvement – High Site Productivity	23,160
Stand Improvement – Moderate Site Productivity (includes high sites on open reference condition soils)	48,210
Stand Improvement – Low Site Productivity (includes moderate sites on open reference condition soils)	18,510
Uneven-aged – High Site Productivity	130,680
Uneven-aged – Moderate Site Productivity (includes high sites on open reference condition soils)	174,930
Uneven-aged – Low Site Productivity (includes moderate sites on open reference condition soils)	50,530
Prescribed Fire Only	31,820
Prescribed Fire Only in protected activity centers	72,130
Aspen Restoration	1,200
Facilitative Operations (FO) Mechanical	121,470
FO Mechanical in protected activity centers	140
FO Prescribed Fire Only	3,070
FO Prescribed Fire Only in protected activity centers	8,760
MSO Recovery – Replacement Nest/Roost	23,010
MSO PAC Mechanical	10,990
MSO PAC Hand Thin	1,190
Savanna Restoration	18,570
Severe Disturbance Area Treatment	135,360
Severe Disturbance Area – in protected activity centers	130
Wildland Urban Interface and Infrastructure Protection	62,690
Grassland Restoration	36,330
Wet Meadow Restoration	6,720
Riparian Restoration	14,570

Table 22. Alternative 2 mechanical and prescribed fire treatment categories and acres within wildland urban interface and critical infrastructure buffer

Proposed Treatment Category	Acres
WUI & Infrastructure Protection	62,684
Decision Tree Treatments	23,149
Aspen Restoration	121
MSO Recovery - Replacement Nest/Roost	2,377
PAC - Hand Thin	9
PAC - Mechanical	1,857
Prescribed Fire Only	14,290
Savanna	3,278
Severe Disturbance Area Treatment	30,846
Facilitative Operations	28,639
Comprehensive Restoration Activities	12,340
No Proposed Treatment	53,781
Grand Total	233,369

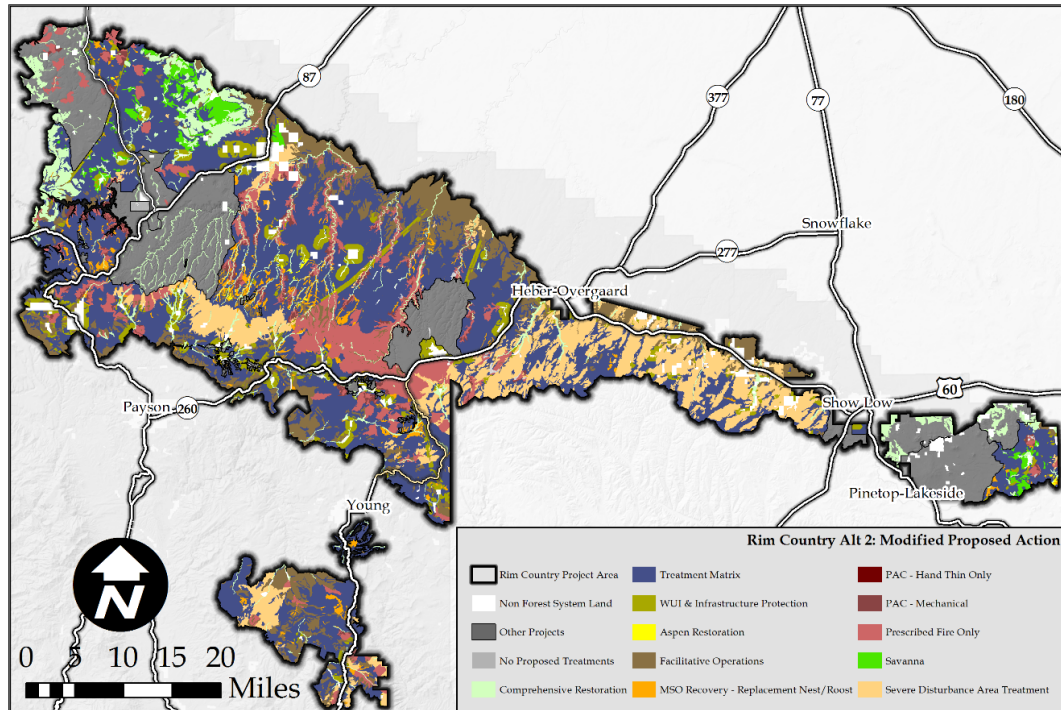


Figure 13. Alternative 2 proposed mechanical and fire treatments

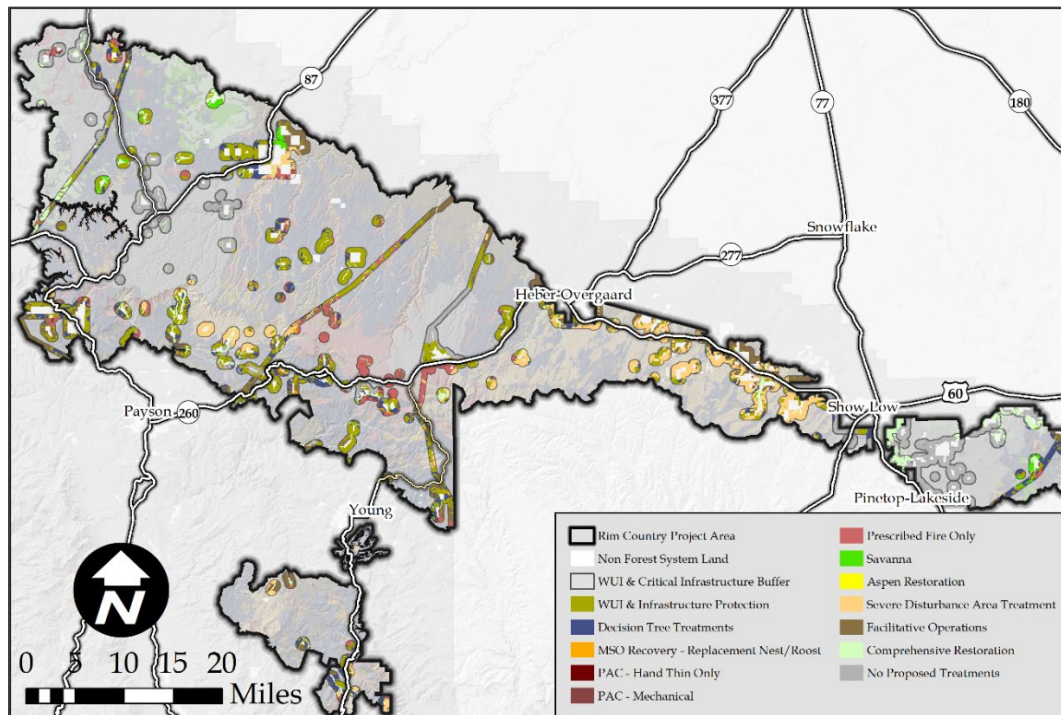


Figure 14. Alternative 2 proposed mechanical and prescribed fire treatments within wildland urban interface and critical infrastructure buffer

Alternative 3 – Focused Restoration

Alternative 3 is designed to focus restoration treatments in areas that are the most highly departed from the natural range of variation of ecological conditions, areas that represent Forest priorities, and/or that are currently putting communities at risk from undesirable fire behavior and effects (see the appendix G: Glossary for a full definition of natural range of variation).

Restoration activities and treatments included in alternative 3 would maintain or restore forest structure and pattern, desired fire regimes, and watershed and ecosystem health and function in ponderosa pine, ponderosa pine-evergreen oak, frequent fire mixed conifer (dry mixed conifer), aspen, and grassland cover types, moving them toward conditions within the natural range of variation. Alternative 3 restoration activities and treatments are designed to achieve the purpose and need over a period of 20 years or until completed. Alternative 3 responds to the treatments in Mexican spotted owl protected activity centers, treatments in northern goshawk habitat, large tree retention, smoke/air quality, and roads issues.

Vegetation treatments (mechanical thinning and prescribed burning), treatment descriptions, and treatment intensities are identical to those described in alternative 2 (the preferred alternative). Because this alternative focuses on the highest priority assets, fewer acres would be treated. This alternative also includes comprehensive restoration treatments, in-woods processing sites, and expansion of existing rock pits that are common between the action alternatives. See the Elements and Activities Common to Alternatives 2 and 3 section for elements and activities that are common between the two action alternatives.

In areas already covered by NEPA decisions (see the Areas Covered Under NEPA Decisions for Inclusion of Restoration Activities section and figure 5), comprehensive restoration activities would occur as outlined in the Elements and Activities Common to Alternatives 2 and 3 section above.

Additional changes made to alternative 3 in response to public comment on the DEIS are detailed in the Changes from DEIS to FEIS section in chapter 1 and the Alternative Development section above.

Proposed Activities

Proposed activities for alternative 3 include:

Mechanically thin trees and/or implement prescribed fire on up to 528,850 acres. The following activities are called out to identify treatments of interest, some treatment acres have overlap.

- Implement mechanical thinning and prescribed fire on up to 256,780 acres.
- Approximately 46,720 acres of stand improvement
- Approximately 210,070 acres of uneven-aged thinning
- Implement prescribed fire alone on approximately 56,640 acres in target vegetation cover types.
- Implement approximately 1,760 acres of mechanical treatment and prescribed fire and approximately 6,320 acres of prescribed fire only in eight inventoried roadless areas (see chapter 3, inventoried roadless area section for information on treatments by inventoried roadless area).
- Mechanically thin and/or implement prescribed fire on approximately 71,630 acres (in target and non-target vegetation cover types) of Mexican spotted owl protected activity centers including:
- Approximately 12,010 acres of mechanical thinning and prescribed fire.

- Approximately 590 acres of hand thinning and prescribed fire.
- Approximately 59,030 acres of prescribed fire only.
- Mechanically thin and/or implement prescribed fire on approximately 110,560 acres of Mexican spotted owl recovery habitat including:
 - Approximately 20,390 acres of mechanical thinning and prescribed fire in Mexican spotted owl replacement nest/roost recovery habitat.
 - Approximately 670 acres of prescribed fire only in Mexican spotted owl replacement nest/roost recovery habitat.
 - Approximately 88,630 acres of mechanical thinning and prescribed fire in Mexican spotted owl foraging /non-breeding recovery habitat.
 - Approximately 880 acres of prescribed fire only in Mexican spotted owl foraging /non-breeding recovery habitat.
- Mechanically thin and/or implement prescribed fire on approximately 17,950 acres of Mexican spotted owl replacement nest/roost recovery habitat.
- Conduct facilitative operations in non-target cover types to support treatments in target cover types, including:
 - Approximately 46,690 acres of facilitative thinning and prescribed fire outside of protected activity centers.
 - Approximately 580 acres of facilitative prescribed fire only outside of protected activity centers.
 - Approximately 3,480 acres of facilitative prescribed fire only in protected activity centers.
 - Approximately 140 acres of facilitative thinning and prescribed fire in protected activity centers.
- Restore aspen on approximately 980 acres.
- Restore approximately 33,320 acres that have experienced severe disturbance, including about 80 acres in protected activity centers.
- Restore approximately 2,470 acres of savanna.
- Protect private property and critical infrastructure on approximately 45,040 acres within a ½ mile of non-Forest System lands with structures and critical infrastructure.
- Construct or improve approximately 170 miles of temporary roads (new and/or occurring on existing unauthorized roads) to facilitate mechanical treatments; decommission all temporary roads when restoration treatments are completed.

Table 23. Alternative 3 mechanical and fire treatments

Treatment Type	Acres
Stand Improvement – High Site Productivity	13,710
Stand Improvement – Moderate Site Productivity (includes high sites on open reference condition soils)	23,640
Stand Improvement – Low Site Productivity (includes moderate sites on open reference condition soils)	9,360
Uneven-aged – High Site Productivity	88,940
Uneven-aged – Moderate Site Productivity (includes high sites on open reference condition soils)	100,000
Uneven-aged – Low Site Productivity (includes moderate sites on open reference condition soils)	21,130
Prescribed Fire Only	2,450
Prescribed Fire Only in PACs	54,200
Aspen Restoration	980
Facilitative Operations (FO) Mechanical	46,690
FO Mechanical in PACs	140
FO Prescribed Fire Only	580
FO Prescribed Fire Only in PACs	3,480
MSO Recovery – Replacement Nest/Roost	17,950
MSO PAC Mechanical	9,600
MSO PAC Hand Thin Only	590
Savanna Restoration	2,470
Severe Disturbance Area Treatment	33,320
Severe Disturbance Area – in PACs	80
Wildland Urban Interface and Infrastructure Protection	45,040
Grassland Restoration	36,330
Wet Meadow Restoration	6,720
Riparian Restoration	14,570

MSO – Mexican spotted owl; PACs – protected activity centers

Table 24. Alternative 3 mechanical and prescribed fire treatments within wildland urban interface and critical infrastructure buffer

Proposed Treatment Category	Acres
WUI & Infrastructure Protection	45,039
Decision Tree Treatments	17,180
Aspen Restoration	121
MSO Recovery - Replacement Nest/Roost	2,172
PAC - Hand Thin	0
PAC - Mechanical	1,507
Prescribed Fire Only	6,614
Savanna	1,604
Severe Disturbance Area Treatment	8,690
Facilitative Operations	15,067
Comprehensive Restoration Activities	12,340
No Proposed Treatment	123,033
Grand Total	233,369

WUI – wildland urban interface; MSO – Mexican spotted owl; PAC – protected area centers

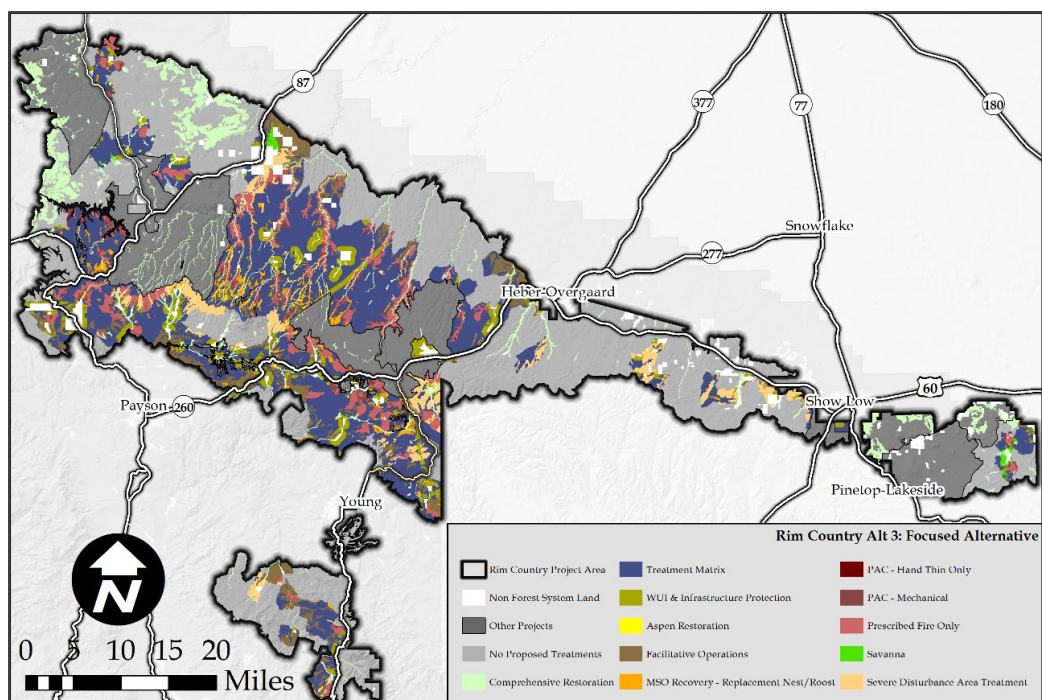


Figure 15. Alternative 3 proposed mechanical and prescribed fire treatments

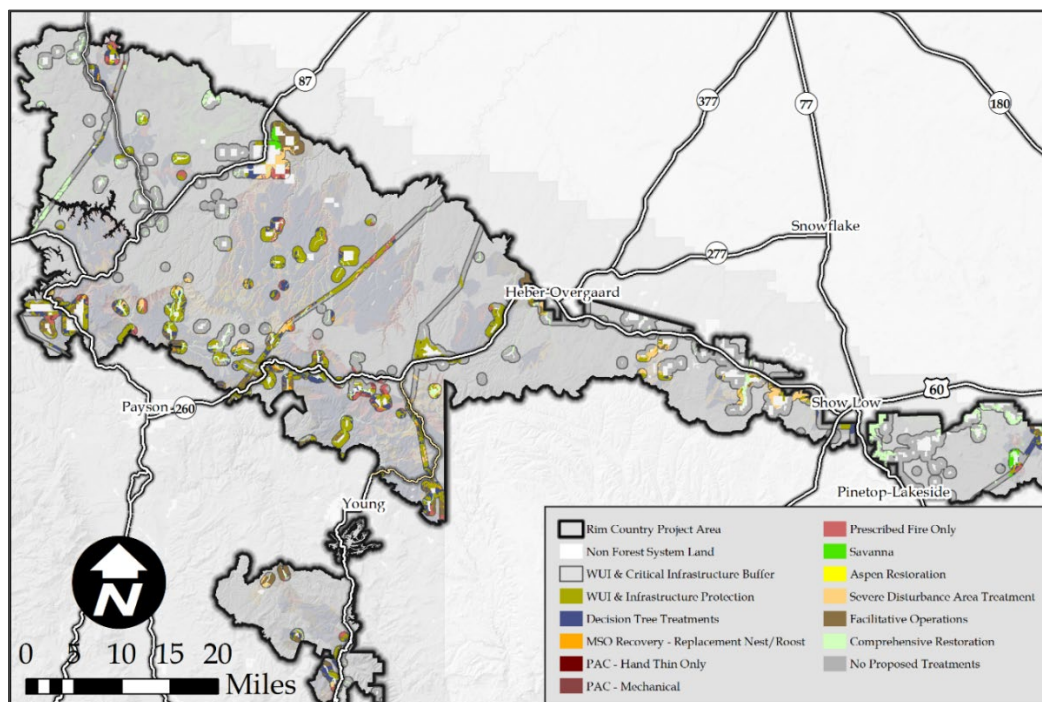


Figure 16. Alternative 3 proposed mechanical and prescribed fire treatments within wildland urban interface and critical infrastructure buffer

Alternatives Considered and Eliminated from Detailed Study

This FEIS documents five (5) alternatives considered and eliminated from detailed study developed from public comments and internal engagement. Public comments suggested four alternative methods to meet the purpose and need, including alternatives that would: (1) eliminate the use of prescribed fire, (2) use the original Large Tree Retention Strategy, (3) return the forest to historic reference conditions, and (4) prioritize strategic treatments for fire use. Forest Service resource specialists developed an alternative (5), the proposed action, that was released during scoping based on best available scientific information. Each alternative was evaluated to determine how well the proposal would meet the purpose and need for the Rim Country Project.

Under 40 CFR 1502.14, a Federal agency must analyze those alternatives necessary to permit a reasoned choice. CEQ regulations direct that an EIS “rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives that were eliminated from detailed study, briefly discuss the reasons for their having been eliminated” (40 CFR 1502.14(a)). The range of reasonable alternatives discussed in environmental impact statements shall encompass those to be considered by the ultimate agency decision maker (40 CFR 1502.2(e)). Section 102(2)(C) provides only that an agency should prepare a detailed statement addressing, among other things, “alternatives to the proposed action” (42 U.S.C. 4332(2)(C)). Section 102(2)(E) requires only that agencies “study, develop, and describe appropriate alternatives to recommended courses of action” (42 U.S.C. 4332(2)(E)). Statements shall be concise, clear, and to the point, and shall be supported by evidence that the agency has made the necessary environmental analyses.

40 CFR 1502.1 specifically directs agencies to consider reasonable alternatives to avoid or minimize adverse environmental impacts.

Eliminate the Use of Prescribed Fire

Some public comments suggested eliminating all prescribed fire (broadcast burns, pile burns, jackpot burning) to reduce hazards from particulate matter and other substances released during burning, to protect the health of the public, to provide cleaner air, and to reduce carbon emissions. Recommendations for alternatives to prescribed fire include logging for fire breaks, chipping, thinning, and goat or cattle grazing.

After an initial review, it was determined that it would not meet various elements of the purpose and need for the Rim Country Project or move toward the desired conditions in the Land Management Plans, such as:

- Eliminating the use of prescribed fire would negatively affect forest structure in terms of moving toward age and size class diversity and desired conditions for forest health. Without the thinning effects of fire on canopy fuels, seedlings, young saplings, and denser conditions could slow stand development and growth (Waring et al 2016). This would result in more of the landscape continuing in the young forest stage. Contrary to the restoration purpose and need, development of the mature and old forest stages would be impeded.
- Mechanical treatments would address some conditions associated with density-related mortality, bark beetle hazard, and dwarf mistletoe infections (Conklin and Geils 2008). However, the pruning effect of fire that would potentially reduce dwarf mistletoe infection severity (Wasserman and Waltz 2018) and additional reduction in tree densities (due to the thinning effect of fire) would not occur. This could lead to further departure from the desired conditions for resiliency and sustainability.

- Without the use of prescribed fire, patterns of surface vegetation would further depart from the natural range of variation as fire-adapted shrubs and herbaceous species decline (Huffman and Moore 2008, Moir et al 1988). Eliminating fire would also have an effect on Gambel oak growth forms and densities. Currently, the Gambel oak population throughout the project area is dominated by seedlings and saplings. Without fire as a regulator of these smaller size classes, both the variety of oak growth forms and densities of seedlings and saplings would continue to be outside of the natural range of variation (Waring et al 2016). This would move the project area away from the desired conditions for forest structure, pattern, and vegetation composition and diversity.
- Mechanical treatments in the project area would be effective initially at restructuring most of the canopy bulk density, canopy base heights, tree density, and the arrangement of trees in the short term (immediately after treatment). However, mechanical treatments have only a minimal effect on seedlings, and provide mineral soil that can increase seedling germination. In order to avoid seedling re-growth that would support undesirable fire behavior and effects, much of the forested areas of the Rim country project area would need some kind of treatment every 10 years, roughly 90,000 acres annually.
- Mechanical treatments alone would not be sufficient to produce effects that simulate regeneration and growth of native herbaceous understory vegetation (move toward desired conditions for vegetation composition and diversity) or reduce the natural surface fuels that have accumulated since the interruption of fire on the landscape (Puhlick et al. 2013). Mosaics created by patterns of litter/duff and other surface vegetation could not be recreated by mechanical means, and species that benefit from the heat or smoke of fire, such as Beardtongue Penstemon, Fendler's Ceanothus, several species of Grama grass, and various species of legumes (Abella et al. 2007, Huffman and Moore 2008, Lata 2015). The negative effects of the heat and smoke of fire on species such as pineland dwarf mistletoe or non-native crabgrasses are beneficial for the native ecosystems they inhabit.
- Accumulations of litter, duff, dead and down woody debris, seedlings, and small saplings would not be reduced. These accumulations, in addition to the debris from mechanical treatments, could result in surface fires that burn at high intensities and lethally scorch tree crowns. It could also result in mortality of large and old trees in the project area.
- High severity fires have the potential to cause second-order fire effects (such as flooding, debris flows, and erosion). This would be contrary to the need to reduce the risk of undesirable fire behavior and effects and move toward forest ecosystems with increased resiliency to wildfires.
- Nutrients would increasingly become locked up in litter layers, and soil productivity would decline, affecting species composition and patterns (Moir 1988; Laughlin et al. 2011; Abella et al. 2007).
- Depending primarily on mechanical means for project implementation, whether it was grazing or machines, this alternative would not meet the purpose and need of the Rim Country Project. The Guidance for Implementation of Federal Wildland Fire Management Policy states:
- Fire, as a critical natural process, is integrated into land management plans and activities on a landscape scale, and across agency boundaries. Response to wildland fire is based on ecological, social, and legal consequences of fire. The circumstances under which a fire occurs, and the likely consequences on firefighter and public safety and welfare, natural and cultural resources, and values to be protected, dictate the appropriate management response to fire.

Fire is a critical natural process, and not including prescribed fire in the Rim Country Project would not meet the purpose and need of the project. The effectiveness of using prescribed fire as a tool, alone or combined with mechanical treatments, to restore ponderosa pine to healthier, more sustainable and resilient conditions is well documented (Fulé et al. 2012).

Grazing was suggested as a method to reduce fuel loading. Grazers would remove the herbaceous vegetation that helps carry a fire across the majority of the project area. To replace the use of prescribed fire, livestock (cattle and goats) would be authorized to graze on up to 899,340 acres. This type of increased use would exceed what is currently permitted in the existing allotment management plans in the Rim Country project area. There would likely be a decline in herbaceous species production and diversity, and possibly an increase in soil compaction across the project area. This is contrary to the purpose and need to improve the abundance, diversity, distribution, and vigor of native understory vegetation to provide food and cover for wildlife, as well as move toward the desired conditions of improved condition and function of streams and springs, grasslands and connected montane meadows, watersheds, and forest ecosystems.

This alternative would respond to Issue 6—Smoke/Air Quality and while it would be possible to use mechanical treatments to move biomass offsite and reduce surface fuels that would have been burned and produced smoke. The costs to implement this would be significant and there would be a large increase in truck traffic that would increase emissions, dust, and degradation to roads. However, mechanical treatment would not replace the role fire has in improving vegetation composition and diversity.

It is estimated that the project area would move away from the desired conditions for forest structure and pattern and resiliency within 10 years of mechanical treatments without the ability use prescribed fire to: (1) stimulate understory vegetation growth; (2) reduce excessive fuel loadings (accumulated since the interruption of fire on the landscape); (3) maintain desired canopy base heights; (4) reduce ladder fuels (attained through mechanical treatment); (5) thin seedlings and small saplings to maintain a mosaic of age classes; and (6) reduce threats to cultural resources and terrestrial and aquatic species habitat.

The use of alternative fuel reduction methods in lieu of prescribed fire could reduce some surface fuels but would not meet the ecological need for a fire-dependent landscape and would add significantly to the cost of restoration. Fire that did occur on the landscape would only be wildfire, and the effects and behavior would be more severe than on a landscape which prescribed fire had been part of the restoration treatments.

Use the Original Large Tree Retention Strategy (LTRS)

Scoping comments recommended incorporating the LTRS as written by the 4FRI Stakeholder Group for the 1st 4FRI EIS analysis. The Forest Service used the original strategy to inform the development of the Rim Country Project Large Tree Implementation Plan (LTIP). The LTIP has the same eight categories as the LTRS but more straightforward and incorporates specifics of the Rim Country Project, and will facilitate more effective implementation (appendix D FEIS).

Return the Forest to Historic Reference Conditions

An alternative that analyzes the effects of “returning the forest to a state closely approximating historic reference conditions, and incorporates an aggressive strategy to achieve the stated goal of comprehensive landscape restoration was proposed during the scoping period. This proposal would have complied with requirements, such as the Endangered Species Act.

The comments suggested a full restoration alternative is needed to consider treating the landscape to the fullest extent that mimics historic conditions that based on studies were projected to have had far less trees per acre on the landscape. Historic conditions are also considered to have a larger number of large trees due to estimated historic fire return intervals.

This type of alternative was considered similar to the evidence-based full restoration alternative considered and evaluated in the 1st 4FRI EIS (USDA FS 2015c), except that it provided additional provisions to meet current direction for retention and improvements to certain habitat types (such as in the Endangered Species Act). Also included would have been the condition-based management approach, including the Old Tree and Large Tree Implementation Plans (OTIP and LTIP).

This alternative would meet the purpose and need to increase ecosystem resiliency and sustainability. It would be compliant with Land Management Plans, Endangered Species Act, and other direction for species preservation.

Having an industry that is sustainable over time helps the Forest Service gain and retain desired forest conditions, provides jobs, and provides products to the American people. The best model for industry sustainability is to provide flow of wood. Part of the purpose and need for the Rim Country Project is supporting sustainable forest product industries, there is concern this alternative would demand treatment of a larger number of acres in the near term (0-20 years), followed by a smaller number of acres in the mid and long term (20+) years (boom-bust model). This does not provide for long-term sustainability which is needed to maintain the forest over time. Therefore, it would not meet the purpose and need for supporting sustainable forest product industries.

It was found when all the conditions were applied to meet Endangered Species Act, habitat and species preservation, OTIP and LTIP, the projection for treatments did not vary by a lot to warrant detailed study. In addition, there was concern by some that the stands that would be available for this type of treatment would warrant more open conditions than desired and may lead to removal of larger trees to meet the prescription. Therefore, the alternative was eliminated from detailed study.

Strategic Treatments for Fire Use Alternative

On March 13, 2018, the Center for Biological Diversity (CBD) submitted an alternative (henceforth known as the Strategic Treatments for Fire Use Alternative) to the 4FRI Board for consideration in the Rim Country analysis. The alternative proposed expanded the use of prescribed fire and wildfires managed for resource benefit, coupled with strategic placement of mechanical treatments using a three-tiered management area approach that provides for Community Protection (Tier 1), Strategic Thinning Treatment (Tier 2), and Fire Use (Tier 3). The management areas were divided as follows:

- Community Protection areas (Tier 1) is defined as ½ mile buffers around homes and critical infrastructure and represents the highest priority for mechanical treatment.
- Strategic Thinning Treatment areas (Tier 2) represent the next priority level for mechanical treatment and are defined through optimization analysis. Condition-based management would be applied within Tier 2.
- Fire Use Management Areas (Tier 3) include all areas not included in Tiers 1 and 2 and would be treated using prescribed fire or fire managed for resource benefit.

A preliminary review by the interdisciplinary team was conducted for the Strategic Treatments for Fire Use Alternative, as proposed, to consider the potential positive and negative effects, and ability to meet desired conditions when compared with alternative 2 and the alternative 3 (40 CFR 1502.14(a)). The

responsible officials examined this review and the original proposal and compared these with what was being proposed in the two action alternatives to determine whether they needed a full analysis for their consideration.

Proposal Analysis Summary

It is likely that the Strategic Treatments for Fire Use Alternative prescribed fire treatment acres could align with those proposed under alternative 2 prescribed fire only acres (though these areas were selected for different purposes and outcomes). Although the three-tier management areas recommended in the proposal are not used, the action alternatives 2 and 3 prioritize treatments around non-Forest Service land with structures and critical infrastructure. Therefore, there is clear alignment between treatments on what would be tier 1 acres in the Strategic Treatments for Fire Use Alternative and the wildland urban interface/critical infrastructure areas of the two action alternatives. Conversely, there is little alignment under alternative 2 and alternative 3 management strategy on most of the landscape proposed for treatment in the Strategic Treatments for Fire Use Alternative.

The Strategic Treatments for Fire Use Alternative would not have met the purpose and need as well as alternative 2 because it proposes to: (1) mechanically treat fewer acres, moving the landscape toward desired conditions to a lesser degree; (2) and has the potential to slow the pace of movement toward desired conditions in Tier 3 areas. Additionally, relative to alternative 2, this alternative may support fewer jobs and provide less labor income in the local economies from reduced forest product removal. Although the Strategic Treatments for Fire Use Alternative may ameliorate some conflicts over mechanical harvest, there is some concern that it may raise the risk of some forms of environmental damage resulting from an increased use of prescribed fire and susceptibility to unplanned ignitions in areas that have not received mechanical treatments. The Strategic Treatments for Fire Use Alternative offers the potential for additional air quality impacts compared to alternative 3 because it relies on a broader use of fire to achieve restoration objectives.

The Strategic Treatments for Fire Use Alternative does not address whether other portions of alternative 2 or alternative 3 such as road decommissioning or aquatic restoration are included. If these treatments are not included, then the purpose and need for aquatic species habitat would not be met. Roads may not be decommissioned, and the drainage network of streams would remain unnaturally high which alters stream hydrology, sedimentation, erosion and ultimately stream habitat. Current riparian and watershed conditions of functioning-at-risk or impaired stream reaches would continue limiting the quality and potentially quantity of aquatic habitat and therefore species occupancy. The Strategic Treatments for Fire Use Alternative does not state how it would contribute to the restoration of aquatic habitats, and mechanical restoration in Tier 3 areas would not occur, potentially limiting the restoration tools available during implementation. This could limit the opportunities to address issues in remote watersheds and/or improve conditions in remote streams or springs.

The proposed mechanical treatments would occur primarily on areas of the landscape with the highest probability to propagate undesirable fire effects. As a result, the proposal does not focus mechanical treatments within stands where primary objectives are to improve forest health such as stand structure, age class diversity, and species diversity. Designated Tier 3 areas would receive burn only treatments without mechanical fuel reduction. In some places, it would be more difficult to control fire behavior, fire severity, and resulting undesirable post-fire effects in areas where mechanical treatments are needed. Mechanical treatments combined with fire could be efficient in moderating the effects of fire only in some of these areas by reducing tree density prior to burning. These mechanical treatments would be prioritized in Tier 2 of the Strategic Treatments for Fire Use Alternative.

Smoke and its impact to communities was raised as a key issue during scoping and alternative 3 was developed partially in response to this issue. As with the action alternatives, all proposed smoke-generating treatments would be performed in accordance with state and federal regulations and clearances. The Strategic Treatments for Fire Use Alternative may require more burning days and increased burn acreages in comparison to alternative 3. Common to all action alternatives, broader windows for burning would need to meet the requirements of Arizona Department of Environmental Quality (ADEQ) especially in areas that would affect large populations. This could restrict the opportunities for burning in some areas and/or under certain weather conditions.

Under the Strategic Treatments for Fire Use Alternative, Tier 3 acres may be on a slower or less certain trajectory toward the natural range of variation, especially if implementation of prescribed fire treatments lags in these areas. As with all alternatives, ultimate progress toward desired conditions will depend not only on the pace and prioritization of implementation, but also on the extent and severity of wildfire. Some forest stands in Tier 3 areas may remain outside of the historic range of variation with regard to structure, pattern, and composition for a longer period and therefore may slow progression toward desired conditions. This slower trajectory in some portions of the landscape does align with the purpose of the Rim Country EIS; which is to move forest conditions toward the desired conditions as described in the Land Management Plans, though it may do so at a slower pace than the modified proposed action.

Under the Strategic Treatments for Fire Use Alternative, fewer mechanical treatments would result in a reduction in the presence of skid trails, landings, and piled or scattered slash which result in a smaller reduction of the scenic quality until harvesting activities are completed and design features are implemented, when compared to the modified proposed action. The reduced effects of the remaining mechanical treatments would be short-term (lasting 1 to 5 years after treatment) and limited to those locations where mechanical treatments would still occur.

All alternatives, including the action alternatives have the potential for high-severity fire effects both during and following implementation. The Strategic Treatments for Fire Use Alternative relies on a broader use of fire as a primary management tool. While this strategy would only be implemented in areas where there is a relatively low probability of high-severity fire effects occurring, there is some potential that this could lead to elevated acres of high-severity effects within the tier 3 portions of the landscape. In areas of high-severity fire, there is potential for damage or loss of soil through removal of organic matter and sterilization of soil degrading habitat for native plant communities. Erosion from high-severity fires can contribute to degradation of aquatic habitats through the deposition of silt, ash, and debris into aquatic systems during post fire flood and surface water runoff events.

Elements Included in the Action Alternatives

Alternative 2 proposes prescribed fire across the project area and would also incorporate the use of any naturally occurring fire contributing to resource benefits. Alternative 3 prioritizes and limits where mechanical treatments are proposed, based on spatial analysis of multiple factors, including protecting highly valued resources and assets against undesirable fire effects, and opportunities for mechanical treatments to yield the greatest restoration benefit.

Alternative 2 includes more than 60,000 acres of prescribed fire only in certain areas. While these areas were selected for different purposes and outcomes than the Strategic Treatments for Fire Use Alternative, treatments on these acres are likely to align with those proposed under the proposed strategic treatments alternative. Although the three-tier management areas recommended in the proposal are not used, action alternatives prioritize treatments around non-Forest Service land with structures and critical infrastructure. Therefore, there is clear alignment between treatments on what would be tier 1 acres in

the Strategic Treatments for Fire Use Alternative and the wildland urban interface/critical infrastructure areas of the two action alternatives. Conversely, there is little alignment in management strategy on most of the landscape proposed for treatment.

One of the main objectives of Rim Country project is to move forested lands toward desired conditions for vegetation age, species diversity and health of the landscape. The use of mechanical treatments and prescribed fire are measures to achieve this objective. Under both the action alternatives and the Strategic Treatments for Fire Use Alternative, not every acre will receive both types of treatments. However, for each area to be treated the ability to use the right tool for the right location is paramount. The conditions based flexible toolbox as utilized in the modified proposed action provides for maximum flexibility of treatment tools across the entire landscape. In the long run, this may better serve to achieve the project's objectives because it eliminates the potential for misaligning treatment techniques on some portions of the landscape due to uncertain conditions.

Under the Strategic Treatments for Fire Use Alternative, fewer mechanical treatments would result in a reduction in the presence of skid trails, landings, and piled or scattered slash which result in a moderate reduction of the scenic quality until harvesting activities are completed, and design features are implemented when compared to the modified proposed action. The reduced effects of the remaining mechanical treatments would be short-term (lasting 1 to 5 years after treatment) and limited to those locations where mechanical treatments would still occur.

Conclusion and summary of rationale for considering and eliminating the Strategic Treatments for Fire Use Alternative from detailed analysis

The Strategic Treatments for Fire Use Alternative meets the purpose and need but not as well as alternative 2, and although it may ameliorate some conflicts over mechanical harvest, there is some concern that it may raise the risk of environmental damage resulting from an increased use of prescribed fire in areas that have not received mechanical treatments. Some concepts from the proposal have been included in alternatives 2 and 3.

Therefore, based on this rationale and in compliance with all applicable laws, regulations, and policy, the responsible officials have determined that the alternatives necessary to permit a reasoned choice were analyzed (40 CFR 1502.14). In accordance with 40 CFR 1502.2(e), the responsible officials determined they had enough information to consider and eliminate from detailed study the Strategic Treatments for Fire Use Alternative.

Comparison of Alternatives

This section provides a summary of the effects from implementing each action alternative. Information in the table is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives.

Table 25. Comparison of alternatives by proposed treatment

Treatment Type	Proposed Activity	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred)	Alternative 3 Focused Alternative
Mechanical Treatments	Stand improvement	No treatments would occur as a result of this alternative being selected	89,880 acres	46,720 acres

Treatment Type	Proposed Activity	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred)	Alternative 3 Focused Alternative
Mechanical Treatments	Uneven-aged thinning	No treatments would occur as a result of this alternative being selected	356,130 acres	210,070 acres
Mechanical Treatments	Aspen restoration	No treatments would occur as a result of this alternative being selected	1,200 acres	980 acres
Mechanical Treatments	Facilitative operations mechanical	No treatments would occur as a result of this alternative being selected	121,610 acres	46,830 acres
Mechanical Treatments	MSO recovery – replacement nest/roost	No treatments would occur as a result of this alternative being selected	23,010 acres	17,950 acres
Mechanical Treatments	MSO PAC – mechanical	No treatments would occur as a result of this alternative being selected	10,990 acres	9,600 acres
Mechanical Treatments	MSO PAC – hand thin	No treatments would occur as a result of this alternative being selected	1,190 acres	590 acres
Mechanical Treatments	Savanna restoration	No treatments would occur as a result of this alternative being selected	18,570 acres	2,470 acres
Mechanical Treatments	Severe disturbance area treatment	No treatments would occur as a result of this alternative being selected	135,490 acres	33,400 acres
Mechanical Treatments	Wildland Urban Interface & Infrastructure Protection	No treatments would occur as a result of this alternative being selected	62,690 acres	45,040 acres
Mechanical Treatments	Grassland restoration ^{1,2} Mechanical subset	No treatments would occur as a result of this alternative being selected	36,290 acres	36,290 acres
Mechanical Treatments	Wet meadow restoration ^{1,3} Mechanical subset	No treatments would occur as a result of this alternative being selected	6,410 acres	6,410 acres
Mechanical Treatments	Riparian restoration ^{1,4} Mechanical subset	No treatments would occur as a result of this alternative being selected	12,790	12,790
Mechanical Treatments	Total mechanical treatment acres	No treatments would occur as a result of this alternative being selected	873,420 acres	466,290 acres
Prescribed Fire Treatments	Prescribed fire along with Mechanical treatment	No treatments would occur as a result of this alternative being selected	873,420 acres	466,290 acres
Prescribed Fire Treatments	Prescribed fire only	No treatments would occur as a result of this alternative being selected	117,640 acres	62,560 acres
Prescribed Fire Treatments	Total prescribed fire treatment acres	No treatments would occur as a result of this alternative being selected	991,060 acres	528,850 acres
Various Comprehensive Restoration Treatments	Springs restored (number)	No treatments would occur as a result of this alternative being selected	184	184

Treatment Type	Proposed Activity	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred)	Alternative 3 Focused Alternative
Various Comprehensive Restoration Treatments	Protective barriers around springs, aspen, native willows and bigtooth maples	No treatments would occur as a result of this alternative being selected	200 miles	200 miles
Various Comprehensive Restoration Treatments	General stream restoration (Heavy mechanical stream restoration subset)	No treatments would occur as a result of this alternative being selected	647 miles (402 miles)	647 miles (402 miles)
Various Comprehensive Restoration Treatments	Existing road decommission	No treatments would occur as a result of this alternative being selected	490 miles	490 miles
Various Comprehensive Restoration Treatments	Unauthorized route decommission	No treatments would occur as a result of this alternative being selected	800 miles	800 miles
Various Comprehensive Restoration Treatments	Temporary road construction and decommission	No treatments would occur as a result of this alternative being selected	330 miles	170 miles
Various Comprehensive Restoration Treatments	Road relocation and reconstruction	No treatments would occur as a result of this alternative being selected	As needed	As needed
Construction and Utilization	In-woods Processing and Storage Sites	0 new sites	12 new sites	12 new sites
Expansion	Rock Pits	No expansion	30 percent expansion of 11 existing rock pits	30 percent expansion of 11 existing rock pits

¹Overlap exists between the riparian, grassland, and wet meadow restoration categories (approximately 3,120 acres). Includes mechanical and prescribed fire and prescribed fire only treatments.

²Total grassland restoration using either mechanical and/or prescribed fire treatments is approximately 36,330 acres.

³Total wet meadow restoration using either mechanical and/or prescribed fire treatments is approximately 6,720 acres.

⁴Total riparian restoration using either mechanical and/or prescribed fire treatments is approximately 14,570 acres.

Comparison of Alternatives by Issue

Table 26. Comparison of alternatives by issue

Issue Indicator/Measure	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Issue 1 – Treatment in MSO PAC Canopy Cover and Basal Area (BA). Metrics are calculated for Mixed Conifer (MC) and Pine-Oak (PO) Cover Types, BA by size class to show medium range trees Size Classes 3 (5-12") and 4 (12-18") are brought closer to desired condition and large trees are promoted as a result of treatment.	Canopy Cover MC: from 66 percent (existing condition) to 71 percent after 10 years of treatment and 74 percent after 20 years Canopy Cover PO: from 65 percent (existing condition) to 69 percent after 10 years of treatment and 71 percent after 20 years BA MC: from 158 inches in the existing condition to 171 after 10 years of treatment and 185 after 20 years BA PO: from 144 inches in the existing condition to 155 after 10 years of treatment and 164 after 20 years The average of all basal areas, from the sapling Size Class 1 to old growth Size Class 6 shows that intermediate-sized trees in both cover types, mixed conifer and ponderosa pine-oak (Size Class 3 with a basal area of 5 to 12 inches and Size Class 4 with a basal area of 12 to 18 inches) would be predominant on the landscape and vastly departed from the natural range of variation and would not be lowered to the desired condition, a result of no treatments after 20 years	Canopy Cover MC: from 66 percent (existing condition) to 60 percent after 10 years of treatment and 61 percent after 20 years of treatment Canopy Cover PO: from 65 percent (existing condition) to 60 percent after 10 years of treatment and 58 percent after 20 years of treatment BA MC: from 158 inches in the existing condition to 126 after 10 years of treatment and 125 after 20 years BA PO: from 144 inches in the existing condition to 116 after 10 years of treatment and 111 after 20 years In mixed conifer 20 years of implementation trees 12-18" DBH are decreased by 1 percent going from 29 percent in the existing condition to 28 percent, which stays near MSO Recovery Plan minimum recommendations of 30 percent. In the ponderosa pine-oak cover type in PACs trees 12-18" DBH go from 27 percent in the existing condition to 30 percent after 20 years of treatment which meets MSO Recovery Plan minimum recommendations of 30 percent. In mixed conifer cover type trees > 18" will go from 33 percent in the existing condition to 48 percent of the trees in PACs greater than 18" after 20 years of implementation. In the pine oak cover type trees >18" go from 25 percent total trees greater than 18" in the existing condition to 37 percent total of trees in the PAC greater than 18" DBH after 20 years of implementation	Canopy Cover MC: from 66 percent (existing condition) to 62 percent after 10 years of treatment and 64 percent after 20 years Canopy Cover PO: from 65 percent (existing condition) to 62 percent after 10 years of treatment and 61 percent after 20 years BA MC: from 158 inches in the existing condition to 133 after 10 years of treatment and 135 after 20 years BA PO: from 144 inches in the existing condition to 122 after 10 years of treatment and 121 after 20 years In mixed conifer 20 years of implementation trees 12-18" DBH are decreased by 1 percent going from 29 percent in the existing condition to 28 percent, which stays near MSO Recovery Plan minimum recommendations of 30 percent. In the ponderosa pine-oak cover type in PACs trees 12-18" DBH go from 27 percent in the existing condition to 30 percent after 20 years of treatment from alternative 3 which meets MSO Recovery Plan minimum recommendations of 30 percent. In mixed conifer cover type trees > 18" will go from 33 percent in the existing condition to 46 percent of the trees in PACs greater than 18" after 20 years of implementation. In the pine oak cover type trees >18" go from 25 percent total trees greater than 18" in the existing condition to 35 percent total of trees in the PAC greater than 18" DBH after 20 years of implementation from alternative 3.

Issue Indicator/Measure	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Fuel loading in Mixed Conifer (MC and Pine-Oak Cover Types, fire hazard index, and risk of crown fire	Fuel loading MC: 26 tons per acre (existing condition) to 30 tons per acre after 10 years of no treatment and 32 tons per acre after 20 years of no treatment. Fuel Loading PO: 19 tons per acre (existing condition) to 23 tons per acre after 10 years of no treatment and 25 tons per acre after 20 years of no treatment. Fire hazard index: The High and Extreme need for treatment increases from 51,002 acres (45 percent of all PACs in the project area) in the existing condition to 58,107 (50 percent) are at risk of high-severity wildfire as a result of no management after 20 years. Active crown fire assessment: from 44,883 acres (39 percent of all PACs in the project area) in the existing condition to 56,795 acres (49 percent) that are at risk of active fire as a result of no management after 20 years.	Surface fuel loading in MSO Protected Habitat would slightly increase under the Proposed Action, moving from an existing 25 tons per acre in MC and 19 tons per acre in ponderosa pine-oak to 26 tons per acre in MC and 19 in ponderosa pine-oak after 20 years of treatment. Timber management will decrease these modeled results by removing the majority of cut material. The Moderate, High, and Extreme Need for Treatment categories of FHI are decreased from alternative 2 in PACs from the existing condition of 70,328 acres (60 percent) to 57,583 acres (49 percent). The High and Extreme Need for Treatment categories are reduced from 51,002 acres (45 percent) of all PACs modeled in the existing condition to 31,831 acres (27 percent) after alternative 2 is implemented. In PACs, the potential for active and conditional crown fire is decreased in alternative 2 compared to the existing condition from 58,765 acres (51 percent) to 38,818 acres (34 percent) of this habitat type in the project area that would experience high-severity crown fire as a result of implementing the proposed action. Active crown fire risk is reduced from 39 percent of all PAC habitat in the project area to 28 percent.	Surface fuel loading in MSO Protected Habitat would slightly increase under alternative 3, remaining at 26 tons per acre in MC and 20 in ponderosa pine-oak after 20 years of treatment. Timber management will decrease these modeled results by removing the majority of cut material. The Moderate, High, and Extreme Need for Treatment categories of fire hazard index are decreased from alternative 3 in PACs from the existing condition of 70,328 acres (60 percent) to 61,066 acres (52 percent). The High and Extreme Need for Treatment categories are reduced from 51,002 acres (45 percent) of all PACs modeled in the existing condition to 38,268 acres (33 percent) after alternative 3 is implemented. In PACs, the potential for active and conditional crown fire is decreased in alternative 3 compared to the existing condition from 58,765 acres (51 percent) to 42,986 acres (37 percent) of this habitat type in the project area that would experience high-severity crown fire as a result of implementing alternative 3. Active crown fire risk is reduced from 39 percent of all PAC habitat in the project area to 33 percent.

Issue Indicator/Measure	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Prey habitat as measured by number of snags/acre ≥ 12 inches in diameter, CWD, and shrub and herbaceous cover. Metrics are calculated for Mixed Conifer (MC) and Pine-Oak (PO) Cover Types.	Snags/acre ≥ 12" MC: from 6/acre (existing condition) to 5/acre after 20 years of no management Snags/acre ≥ 12" PO: from 3/acre (existing condition) to 4/acre after 20 years of no management CWD MC: from 9 tons per acre (existing condition) to 11 tons per acre after 10 years of no treatment and 1 ton per acre after 20 years. CWD PO: from 8 tons per acre (existing condition) to 9 tons per acre after 10 years of no treatments and 10 tons per acre after 20 years Shrub cover MC: from 0.36 ton per acre (existing condition) to 0.34 ton per acre after 10 years of no treatment. and 0.31 after 20 years Shrub cover PO: from 0.24 (existing) with no change after 20 years of no treatment Herbaceous cover MC and PO: from 0.21 ton per acre (existing condition) to 0.19 in MC and 0.21 (no change) in Pine Oak. after 20 years of no management	Snags/acre ≥ 12" MC: from 6/acre (existing condition) to 9/acre after 10 years of treatment and 8/acre after 20 years Snags/acre ≥ 12" PO: from 3/acre (existing condition) to 7/acre after 20 years of treatment CWD MC: from 9 tons per acre (existing condition) to 11/tons per acre after 20 years of treatment CWD PO: from 8 tons per acre (existing condition) to 9 tons per acre after 20 years of treatment Shrub cover MC: from 0.36 ton per acre (existing condition) to 0.56 ton per acre after 10 years of treatment and 0.64 ton per acre after 20 years Shrub cover PO: from 0.24 (existing) to 0.22 after 20 years of treatment Herbaceous cover MC: from 0.21 ton per acre (existing condition) to 0.25 ton per acre after 20 years of treatment Herbaceous cover PO: from 0.21 ton per acre (existing condition) to 0.23 ton per acre after 20 years of treatment	Snags/acre ≥ 12" MC: from 6/acre (existing condition) to 09/acre after 10 years of treatment and 07/acre after 20 years Snags/acre ≥ 12" PO: from 3/acre (existing condition) to 7/acre after 10 years of treatment and 07/acre after 20 years CWD MC: from 9 tons per acre (existing condition) to 11 tons per acre after 20 years of treatment CWD PO: from 8 tons per acre (existing condition) to 9 tons per acre after 20 years of treatment Shrub cover MC: from 0.36 ton per acre (existing condition) to 0.50 ton per acre after 10 years of treatment and 0.57 ton per acre after 20 years. Shrub cover PO: from 0.24 (existing) to 0.23 after 20 years of treatment Herbaceous cover MC: from 0.21 ton per acre (existing condition) to 0.23 ton per acre in after 20 years of treatment. Herbaceous cover PO: from 0.21 ton per acre (existing condition) to 0.22 ton per acre after 20 years of treatment
Issue 2 – Treatments in Northern Goshawk Habit (PFAs) Forest Variables as measured FVS reduction of average BA of large young trees Size Classes 3 (5-12 inches) and 4 12-18 inches. Retain and increase large trees and snags in PFAs	BA of Tree Size Classes: In PFAs the FVS modeling of the effects of treatments on northern goshawk for alternative 1, no action, show that the average of all basal area and canopy cover would continue to increase with basal area increasing from 134 (existing) to 155 after 20 years of no management. Mid-aged forest (BA3, 5-12 inches, and BA4, 12-18 inches) would continue to dominate the landscape and represent a huge shift in the Natural Range of Variation of the forested ecosystem. Trees greater than 18" increase from 27 percent of all trees in theses age classes in the existing condition to 31 percent as a result of no treatment after 20 years from alternative 1. Trees greater than 18 inches represent 31 percent (27 percent existing) of the trees in PFAs as a result of no treatment.	BA of Tree Size Classes: In PFAs the FVS modeling of the effects of treatments on Northern goshawk for alternative 2, the proposed action show that the average of all basal area and canopy cover would decrease with basal area decreasing from 134 (existing) to 76 after 20 years of treatment. However, large trees greater than 18 inches would increase as a result of treatment from alternative 2 (see below). Mid-aged forest (BA3, 5-12 inches, and BA4, 12-18 inches) would be treated to attain the desired condition, reducing these size classes to better represent uneven-aged management. Trees greater than 18 inches increase from 27 percent of all trees in theses age classes to 57 percent as a result of treatment after 20 years from alternative 2.	BA of Tree Size Classes: In PFAs the FVS modeling of the effects of treatments on Northern goshawk for alternative 3, show that the average of all basal area and canopy cover would decrease with basal area decreasing from 134 (existing) to 95 after 20 years of treatment. However, large trees greater than 18 inches would increase as a result of treatment from alternative 3 (see below). Mid-aged forest (BA3, 5-12 inches, and BA4, 12-18 inches) would be lowered from alternative 3 treatments, though not to the desired conditions. Trees greater than 18 inches increase from 27 percent of all trees in these age classes to 46 percent as a result of treatment after 20 years from alternative 3.

Issue Indicator/Measure	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Fuel loading, fire hazard index, and risk of crown fire	Fuel loading: from 17 tons per acre (existing condition) to 22 tons per acre after 20 years of no treatment Fire hazard index and risk of crown fire was modeled in PFAs as a result of alternative 1, no action. Of the 41,590 acres modeled 13,459 acres (33 percent) of the PFAs in the project area could potentially experience high-severity wildfire. This is increased from 28 percent in the existing condition. The risk of crown fire was modeled in PFAs as a result of alternative 1, no action. Approximately 15,950 acres (39 percent) of PFAs in the Rim Country project area are at risk of experiencing active or conditional crown fire, which is increased from 36 percent in the existing condition	In PFAs and in fuel loads in average of tons per acre decrease significantly from 17 tons per acre (existing condition) to less than 10 tons per acre after 20 years under alternative 2. Fire hazard index and risk of crown fire was modeled in PFAs as a result of alternative 2, The Proposed Action. Of the 41,590 acres modeled 2,832 acres (7 percent) of the PFAs in the project area could potentially experience high or extreme severity wildfire. This is decreased from 28 percent in the existing condition. The risk of crown fire was modeled in PFAs as a result of alternative 2, The Proposed Action. Approximately 5,071 acres (12 percent) of PFAs in the Rim Country project area are at risk of experiencing active or conditional crown fire, which is decreased from 36 percent in the existing condition.	In PFAs and in fuel loads in average of tons per acre decrease significantly from 17 tons per acre (existing condition) to less than 14 tons per acre after 20 years under alternative 3. Fire hazard index and risk of crown fire was modeled in PFAs as a result of alternative 3, The Focused Alternative. Of the 41,590 acres modeled 4,661 acres (11 percent) of the PFAs in the project area could potentially experience high or extreme severity wildfire. This is decreased from 28 percent in the existing condition. The risk of crown fire was modeled in PFAs as a result of alternative 3. Approximately 6,808 acres (17 percent) of PFAs in the Rim Country project area are at risk of experiencing active or conditional crown fire, which is decreased from 36 percent in the existing condition.
Prey habitat as measured by number of snags/acre ≥ 12 inches in diameter, CWD, and shrub and herbaceous cover	Snags/acre ≥ 12 inches: from 2/acre (existing condition) to 2/acre after 20 years of no treatment. No change CWD: from 6 tons per acre (existing condition) to 8 tons per acre after 20 years of no treatment Shrub cover: from 0.25 tons/ acre (existing condition) to 0.24 ton per acre in after 20 years of no treatment. Herbaceous cover: from 0.21 ton per acre (existing condition) with no change after 20 years of no treatment	Snags/acre ≥ 12 inches: from 3/acre (existing condition) to 5/acre after 20 years of treatment. CWD: from 6 tons per acre (existing condition) to 6 tons per acre (no change) after 20 years of treatment. Shrub cover: from 0.25 ton per acre (existing condition) to 0.32 ton per acre after 20 years of treatment Herbaceous cover: from 0.21 ton per acre (existing condition) to 0.25 ton per acre after 20 years of treatment.	Snags/acre ≥ 12 inches: from 3/acre (existing condition) to 5/acre after 20 years of treatment. CWD: from 6 tons per acre (existing condition) to 7 tons per acre after 20 years of treatment. Shrub cover: from 0.25 ton per acre (existing condition) to 0.33 ton per acre after 20 years of treatment. Herbaceous cover: from 0.21 ton per acre (existing condition) to 0.24 ton per acre after 20 years of treatment.
Issue 3 – Large Tree Retention Acres meeting SPLYT criteria (Existing Condition / After 20 years of treatment)	44,742 / 87,098	44,742 / 77,397	31,324 / 51,822 (from within alternative 3 acreage only)
Issue 5 – Economics Volume of wood products available	Ongoing projects will continue to provide some amount with no contribution from the Rim Country Project	5. MMCCF	3.6 MMCCF
Economic efficiency (project benefits/value less costs)	No direct project benefits or costs; no economics of scale in forest restoration activities	Avoided costs from forest restoration and reduced risk of high-severity wildfire	Avoided costs from forest restoration and reduced risk of high-severity wildfire; more concentrated treatments (compared to alternative 2) would lower operating costs

Issue Indicator/Measure	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Changes in employment (jobs created) and labor income	Three national forests would continue to support local employment and labor income associated with harvesting, grazing and recreation at levels similar to current conditions	2,040 jobs and \$86 million dollars in labor income	1,370 jobs and \$58 million dollars in labor income
Issue 6 – Smoke/Air Quality Potential for wildfire and prescribed fire emissions	Smoke and associated emission impacts on air quality would come solely from wildfire events. These events would be unpredictable in both magnitude and timing, with the potential for large effects to air quality. Wildfire related emissions would be expected infrequently (a few times a year). Overall, smoke impacts would be less predictable, less frequent, and more concentrated than impacts from the prescribed fires proposed for alternatives 2 and 3.	Smoke and associated impacts on air quality would come primarily from prescribed fire and more than alternative 3. Wildfire would continue to occur, but per acre emissions for wildfires occurring of implementation would be reduced compared with alternatives 1 and 3. Variability from year to year in total smoke related emissions would be high, but overall, smoke effects would be more predictable, less concentrated, though potentially more frequent than wildfire related emissions associated with alternative 1. All prescribed fire treatments would comply with National Ambient Air Quality Standards.	In treated areas, smoke and associated effects on air quality would come primarily from prescribed fire and less than alternative 2, while smoke from untreated areas would be generated from wildfires and more than alternative 2. Areas burned with prescribed fire would produce lower emissions per acre than untreated acres burned by wildfires. All prescribed fire treatments would comply with National Ambient Air Quality Standards.
Level of modelled criteria air pollutants and greenhouse gases	Modeled Wildfire Emissions: Criteria Air Pollutants PM2.5 – 0.14-0.26 ton per acre PM10 – 0.16-0.30 ton per acre Carbon Monoxide – 1.55-2.96 tons per acre Sulfur Dioxide – 0.02-0.03 ton per acre Nitrogen Dioxide - 0.03-0.05 ton per acre Greenhouse Gases CO23 - 27-45 tons per acre If the entire project area were to burn in an uncontrolled wildfire the criteria air pollutant emissions would be approximately 461-684 percent, and greenhouse gas emissions would be approximately 566 percent of Arizona annual statewide prescribed fire emissions.	Modeled Prescribed Fire Emissions: Criteria Air Pollutants PM2.5 – 0.10-0.21 ton per acre PM10 – 0.10-0.25 ton per acre Carbon Monoxide – 1.04-2.70 tons per acre Sulfur Dioxide – 0.01-0.02 ton per acre Nitrogen Dioxide – 0.01-0.03 ton per acre Greenhouse Gases CO2e – 9-27 tons per acre Six different treatment scenarios described under alternative 2 would produce approximately 37-118 percent of criteria air pollutant emissions, and approximately 46-98 percent of greenhouse gas emissions compared to Arizona annual statewide prescribed fire emissions.	Modeled Prescribed Fire Emissions: Criteria Air Pollutants PM2.5 – 0.10-0.21 ton per acre PM10 – 0.10-0.25 ton per acre Carbon Monoxide – 1.04-2.70 tons per acre Sulfur Dioxide – 0.01-0.02 ton per acre Nitrogen Dioxide – 0.01-0.03 ton per acre Greenhouse Gases CO2e – 9-27 tons/acre Six different treatment scenarios described under alternative 3 would produce approximately 20-64 percent of criteria air pollutant emissions, and approximately 25-52 percent of greenhouse gas emissions compared to Arizona annual statewide prescribed fire emissions.

Issue Indicator/Measure	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Effects of smoke on quality of life and tourism	This alternative would not result in smoke emissions from prescribed fire in the project area. Smoke from wildfires, though unpredictable in frequency and duration, would be likely to adversely affect quality of life and tourism over both the short and long terms. Because this alternative would not reduce fuel loading, wildfires in the project area would likely produce more smoke and particulate matter compared with wildfires in treated areas or prescribed fires. Because wildfires are unplanned there is little potential to work with fire managers to reduce smoke impacts in areas when fires occur. High-severity fires in untreated areas are likely to result in substantial tree mortality and post-fire effects that have the potential to negatively affect quality of life and tourism for forest users.	Prescribed burns would have short-term and minimal negative effects to quality of life and tourism during implementation, and long-term benefits from reduced risk of severity of wildfire. Mechanical treatments would reduce fuel loading so that prescribed fires and wildfires in treated areas would be likely to emit less smoke and particulate matter. Wildfires in treated areas would be less likely to kill entire stands, thus protecting resources and forest characteristics that contribute to quality of life and tourism in the area.	Prescribed burns would have short-term and minimal negative effects to quality of life and tourism during implementation, and long-term benefits from reduced hazard and severity of wildfire. Mechanical treatments would reduce fuel loading so prescribed fires and wildfires in treated areas would emit less smoke and particulate matter. Compared to alternative 2, benefits of reduced fire hazard and potential negative, short-term effects would occur across a smaller area. Wildfires in treated areas would be less likely to kill entire stands, protecting resources and forest characteristics that contribute to quality of life and tourism in the area.
Issue 7 – Roads # of miles temporary roads needed	0 miles	330 miles	170 miles

Comparison of Alternatives by Effects

Table 27. Comparison of alternatives by effects

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Water Quality	Upland and riparian vegetation, soil productivity, and wetland function would not be restored to desired conditions. Degrading contributors to water quality would continue to persist.	Localized, short-term changes in water quality due to sediment concentrations are possible in water bodies adjacent to project activity areas. Risk to long-term surface water quality is expected to decrease more rapidly and over a larger extent when compared to alternative 3 by bringing upland and riparian vegetation, soil productivity, and wetland function to desired conditions.	Same as alternative 2 with the exception of substantially fewer upland acres treated with mechanical vegetation and prescribed burning treatments in forested conditions (48 percent less) and grasslands and savannahs (28 percent) less and prescribed burning treatments. Prescribed burning only acres are 26 percent less. Therefore, potentially fewer short-term effects and long-term benefits to water quality.
Water Quantity	Water yield including persistence of flow and stability of hydrologic flow regimes would likely continue to decline as a result of continued departure from desired conditions.	Water yield may increase depending on vegetation type and climate variables. More stable hydrologic regimes are expected as a result of moving resources toward desired conditions.	Due to fewer acres being treated through mechanical vegetation treatments and prescribed burning overall water yield and stability may be lower than in alternative 2 but greater than in alternative 1.
Riparian Zones	Degradation of riparian systems would continue unabated, with reduced function and stability of riparian areas, wetlands, and springs.	Vegetation treatments, including mechanical thinning and prescribed burning along with other aquatic and watershed treatments, would increase water availability and stability to riparian areas, wetlands, and springs. Riparian vegetation and stream habitats would be restored and maintained.	Fewer acres would receive mechanical vegetation and prescribed burning treatments than alternative 2, resulting in potentially less water availability for supporting riparian areas, wetlands, and springs and restoration of fewer areas of riparian vegetation and stream habitat.
Watershed Condition	There would be no discernable change in watershed condition. Current rates of watershed restoration are insufficient to fully restore watershed functionality at the landscape scale.	Watershed condition would be improved throughout the project area with implementation of the suite of proposed restoration actions.	Watershed condition would improve throughout the Rim Country analysis area, just not to the extent provided by Alternative 2.

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Soil Condition	With no activities resulting from the Rim Country Project, no additional soil disturbance or displacement would occur beyond existing projects for which NEPA analysis has been completed. By not decommissioning or relocating roads as part of the Rim Country Project, soil conditions on those roads will not be improved.	Greatest soil disturbance and displacement would occur with short-term negative effects throughout much of the Rim Country analysis area. As a result of proposed restoration treatments, Alternative 2 would achieve desired condition for soils and watershed over the long term by removing sufficient canopy cover to allow sunlight to penetrate to the forest floor, increasing growth response of grasses, forbs and shrubs. In the long term, increased fine roots and vegetative ground cover would protect soils from erosion by wind and water better than forest litter alone, providing the greatest long term soil condition improvement. Road decommissioning would improve soil condition on former roadbeds.	Less soil disturbance and displacement than alternative 2, resulting in less short-term adverse effects to soils. Would not achieve desired conditions at the landscape scale for soils over the long-term since it would result in treatment of only the highest priority areas. Soil nutrient cycling would progress toward the desired condition in treated areas, which are substantially less than alternative 2. Untreated areas would continue to have less understory vegetative cover. The litter layer, or duff would continue to provide soil nutrients and contribute to soil profile development, but not to the extent provided by grasses, forbs, and shrubs in Alternative 2. Road decommissioning would improve soil condition on former roadbeds.
Forest Structure - General	Stand structure would continue to not meet the desired conditions as smaller trees are overrepresented. This trend would be expected to continue, leading to increased density dependent mortality, while basal area and stand density index (SDI) would continue to increase. The number of trees per acre and basal area and SDI would move further away from the natural range of variation (NRV) and the desired conditions. This trend would be expected to continue. Insect hazard rating and severity of dwarf mistletoe infections would continue to increase.	Stand structure would move toward desired conditions as trees would be well distributed across size classes. The number of trees per acre, basal area, and SDI would decrease considerably, trending toward desired conditions within NRV as a result of thinning and prescribed fire activities. Insect hazard rating and dwarf mistletoe severity would be reduced in treated areas, thus moving toward the desired conditions.	In general, the effects would be similar to the effects of Alternative 2, with a muted effect due to the fewer number of acres treated, and would only be observed in the stands treated. The number of trees per acre, basal area, and SDI would decrease considerably, trending toward desired conditions within NRV as a result of thinning and prescribed fire activities. Insect hazard rating and dwarf mistletoe severity would be reduced in treated areas, thus moving toward the desired conditions.
Forest Structure - Pattern	Stands would continue to remain in a closed condition, lacking groups and clumps of trees or randomly spaced trees. Grasses forbs and shrubs would continue to be underrepresented. Forest structure would continue to be departed from historic conditions.	This alternative would generally meet the desired condition. The majority of stands would be in an open condition. Forest arrangement would be in individual trees, small clumps, and groups of trees or randomly spaced trees that are similar to historic patterns and are as a result of the proposed action. Most forest stands in uneven-aged condition to meet forest resilience and sustainability goals while maintaining wildlife habitat.	This alternative would generally meet the desired condition on the acres that were treated, however the acres that were not treated would resemble the conditions described in the no action alternative. Forest arrangement would resemble historic forest structure in some places, while many other areas would not meet the desired condition for forest pattern and structure.

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Forest Structure – Trees per Acre	Total trees per acre continues to remain above the desired condition. The percentage of acreage in the project within desired condition moves up from 17 percent in existing condition to 19 percent after 20 years as a result of density-dependent mortality. Tree distribution does not approximate the idealized distribution with too many trees in the smaller size classes. After 20 years there would be 553, 114, 36, 11, and 3 trees in the 0-5", 5-12", 12-18", 18-24" and 24"+ size classes, respectively.	The percentage of acreage within desired condition for trees per acre increases dramatically from 17 percent in existing condition to 93 percent after 20 years of treatment. The distribution of trees across size classes approximates the idealized distribution after 20 years better than any of the other alternatives. After 20 years there would be 35, 12, 11, 7, and 3 trees in the 0-5", 5-12", 12-18", 18-24" and 24"+ size classes, respectively.	The percentage of acreage within desired condition for trees per acre increases from 17 percent in the existing condition to 60 percent after 20 years of treatment. Tree distribution does not approximate the idealized distribution with too many trees in the smaller size classes. After 20 years there would be 210, 45, 19, 8 and 3 trees in the 0-5", 5-12", 12-18", 18-24" and 24"+ size classes, respectively.
Forest Structure – Basal Area	Average basal area would continue to increase across the project area from 115 square feet per acre in the existing condition to 137 square feet per acre after 20 years. The percentage of acres that would meet desired condition decreases from 25 percent in the existing condition to 19 percent after 20 years.	Average basal area would decrease across the project area from 115 in the existing condition to 53 after 20 years. The percentage of acres that meet desired condition would increase from 25 percent in the existing condition to 66 percent after 20 years.	Average basal area would decrease across the project area from 115 in the existing condition to 79 after 20 years. The percentage of acres that meet desired condition for basal area would increase from 25 percent in the existing condition to 49 percent after 20 years.
Forest Structure – Stand Density Index	Average stand density index would continue to increase across the project area from 263 in the existing condition to 296 after 20 years. the percentage of acres that would meet desired condition decreases from 18 percent in existing condition to 14 percent after 20 years.	Average stand density index would decrease across the project area from 263 in the existing condition to 86 after 20 years. The percentage of acres that meet desired condition would increase from 18 percent in existing condition to 20 percent after 20 years.	Average stand density index would decrease across the project area from 263 in the existing condition to 151 after 20 years. The percentage of acres that meet desired condition would increase from 18 percent in existing condition to 22 percent after 20 years.
Forest Insects	The proportion of acreage that would meet the desired condition for bark beetle hazard decreases from 31 percent in the existing condition to 19 percent after 20 years as a result of increased stocking and lack of disturbance over time.	The proportion of acreage that would meet the desired condition for bark beetle hazard would increase from 31 percent in the existing condition to 97 percent after 20 years.	The proportion of acreage that meet the desired condition for bark beetle hazard would increase from 31 percent in the existing condition to 63 percent after 20 years.

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Forest Disease	The proportion of acreage with a severe dwarf mistletoe rating would increase from 4 percent in the existing condition to 10 percent after 20 years. The proportion of acreage that meets the desired condition decreases from 96 percent in the existing condition to 90 percent after 20 years.	The proportion of acreage with a severe dwarf mistletoe rating would decrease from 4 percent in the existing condition to 3 percent in after 20 years. The proportion of acreage that meets the desired condition would increase from 96 percent in the existing condition to 97 percent after 20 years.	The proportion of acreage with a severe dwarf mistletoe rating would increase from 4 percent in the existing condition to 5 percent after 20 years. The proportion of acreage that meets the desired condition would decrease from 96 percent in the existing condition to 95 percent after 20 years.
Fire Ecology	Fire Type: Wildfires would continue to impact the project area, though no prescribed burning would occur. Existing conditions, which are currently prone to high-severity crown fire would only worsen. Conditions across 79 percent of the project area would be capable of supporting active or passive crown fire under extreme fire weather conditions. This includes approximately 32 percent of the project area with potential for active crown fire. Fire Hazard Index: 39 percent of the project area would have moderate to extreme Fire Hazard Index ratings, representing difficult and dangerous conditions for fire suppression during wildfire events and elevated potential for adverse post fire effects to soils and surface water quality. Surface Fuel Loading: Total surface fuel loading would continue to accumulate. Nearly 102,000 acres of the Ponderosa Pine cover type and approximately 19,000 acres of the Dry Mixed Conifer cover type would exceed desired conditions for fuel loading after 20 years of additional accumulation.	Fire Type: Wildfires occurring within the project area would generally be less likely to burn with high-severity. Existing susceptibility to crown fire would be reduced. Conditions across 60 percent of the project area would be capable of supporting active or passive crown fire under extreme fire weather conditions. This would include 11 percent of the project area with the potential for active crown fire under these extreme fire weather conditions. Prescribed fire would be predominantly surface fire. Fire Hazard Index: There would be an overall decrease in the Fire Hazard Index, with only 21 percent of the project area in moderate to high ratings. This would decrease the overall area where difficult and dangerous conditions for fire suppression during wildfire. Surface Fuel Loading: Total surface fuel loading would fluctuate during implementation, but overall would decrease in most portions of the project area with the exception of areas proposed for MSO treatments. Approximately 24,000 acres of the Ponderosa Pine cover type and 8,700 acres of the Dry Mixed Conifer cover type would exceed desired conditions for fuel loading.	Fire Type: In treated areas, wildfires would generally be less likely to burn with high-severity, though untreated areas would continue to have elevated potential for high-severity fire. Conditions across 70 percent of the project area would be capable of supporting active or passive crown fire under extreme fire weather conditions. This would include 18 percent of the project area with the potential for active crown fire under these extreme wildfire conditions. Fire Hazard Index: Treated areas would lead to an overall decrease in Fire Hazard Index ratings, though untreated areas would continue to contribute to elevated fire hazard index ratings. 26 percent of the project area is expected to have moderate to high Fire Hazard Index ratings. Surface Fuel Loading: In treated areas, total surface fuel loading would fluctuate during implementation, and decrease overall, with the exception of areas proposed for MSO treatments. Untreated areas would see continued accumulations of surface fuels. Approximately 47,000 acres of the Ponderosa Pine cover type and 9,800 acres of the Dry Mixed Conifer vegetation type would exceed desired conditions for fuel loading.

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Air Quality	Smoke and associated emission impacts on air quality would come solely from wildfire events. These events would be unpredictable in both magnitude and timing, with the potential for large effects to air quality. Wildfire related emissions would be expected infrequently (a few times a year). Overall, smoke impacts would be less predictable, less frequent, and more concentrated than impacts from the prescribed fires proposed for alternatives 2 and 3.	Smoke and associated impacts on air quality would come primarily from prescribed fire and more than alternative 3. Wildfire would continue to occur, but per acre emissions for wildfires occurring of implementation would be reduced compared with alternatives 1 and 3. Variability from year to year in total smoke related emissions would be high, but overall, smoke effects would be more predictable, less concentrated, though potentially more frequent than wildfire related emissions associated with alternative 1. All prescribed fire treatments would comply with National Ambient Air Quality Standards.	In treated areas, smoke and associated effects on air quality would come primarily from prescribed fire and less than alternative 2, while smoke from untreated areas would be generated from wildfires and more than alternative 2. Areas burned with prescribed fire would produce lower emissions per acre than untreated acers burned by wildfires. All prescribed fire treatments would comply with National Ambient Air Quality Standards.

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Wildlife	Under the no action alternative, most wildlife habitat would move toward desired conditions more slowly than with the action alternatives, while some habitat may not move toward desired conditions at all. No acres are proposed for mechanical treatment or prescribed fire, so the project area would have less tree age class-diversity than with the action alternatives. Specifically, alternative 1 would result in the lowest proportion in grass-forb-shrubs, seedlings, and saplings; the highest proportion in mid-aged forest; and the lowest proportion in older tree age classes. Alternative 1 would result in the slowest progress of all alternatives toward desired conditions of higher proportions of older age classes within uneven-aged forest conditions.	Northern goshawk: Within post-fledging family habitat (PFA), in ponderosa pine habitat. Average basal area and canopy cover would decrease, along with stand density index (SDI), which Mid-aged forest in age class 3 (5-12" in diameter), and age class 4 (12-18") would be greatly reduced, meeting desired conditions for these age classes in 30 years. MSO: There could be increased disturbance to individual MSO from noise or smoke in the short term. Given restoration project objectives, the scale of the cumulative effects area, the distribution of MSO habitat across the project area, and the length of time over which treatments would be implemented alternative 2 is not expected to negatively affect MSO population in the long term. Treatments in MSO habitat should move forest conditions toward desired conditions and decrease the risk of habitat loss to large-scale high-severity fire. Snags of all size classes important to wildlife species would increase. Coarse woody debris and downed logs important to prey and wildlife species would increase over the 20 years modeled. Herbaceous and shrub layers, also important to prey and wildlife species, would increase or be maintained. Various other restoration activities (grassland and meadow restoration, spring restoration, riparian stream and stream channel restoration, stream habitat restoration, and aspen restoration) would occur under alternative 2 to benefit wildlife.	Alternative 3 treats goshawk habitat with slightly less restoration to bring about desired conditions. Northern goshawk: Within PFA habitat, in ponderosa pine the average of all basal area and canopy cover would after 20 years. Mid-aged forest (BA3, 5-12 inches, and BA4, 12-18 inches) would be greatly reduced under Alternative 3, bringing these age classes closer to desired conditions after 20 years. MSO: Alternative 3 would treat fewer acres of MSO habitat in Rim Country. Alternative 3 includes the same number of miles and acres of riparian and other habitat restoration, while reducing the total number of acres thinned and treated with prescribed burning. In PACs, 24,045 fewer acres would be thinned and burned. In Recovery Nest/Roost Habitat, 7,545 fewer acres would be treated in alternative 3. In Foraging/Non-breeding MSO Recovery Habitat 51,920 fewer acres would be treated in alternative 3. Savannah treatments in alternative 3 would be reduced by 15,190 acres, providing less restoration to benefit the MSO prey base. While short-term effects from disturbance would be reduced in alternative 3, the long-term effects and risk of habitat degradation from stand-altering wildfire or insect infestations would be greater than under alternative 2. Snags of all size classes important to wildlife species would increase in the treated acres and in the untreated acres. Coarse woody debris and downed logs important to prey and wildlife species would increase over the 0 years modeled. Herbaceous and shrub layers, also important to prey and wildlife species, would increase or be maintained in the acres treated. The higher number of untreated acres, relative to alternative 2, leaves habitat at a greater risk of high-severity wildfire that could result in more severe effects on ecosystem components than those which would occur as part of a natural fire regime. Fewer acres of habitat would be restored and conserved for wildlife in alternative 3 than in alternative 2. Other restoration activities beneficial to wildlife species are the same as in alternative 2.

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Aquatic Species	By not moving vegetation toward desired conditions and a more natural fire regime, riparian and watershed condition would remain the same or degrade over time. The hazard of undesirable fire behavior and negative fire effects to aquatic resources would remain. Riparian condition and instream aquatic habitat would remain in the current state or degrade further over time. There would be no decrease in road density or improvement of riparian condition from decommissioning or relocating roads.	Vegetation treatments (fire and mechanical) will have short- term negative impacts to aquatic species and habitats, but will have the most long-term benefits by promoting or improving riparian and watershed condition by increasing forest resiliency and reducing road density. Opening ML-1 roads would have negative impacts to aquatic species while in use. The risk of undesirable fire behavior and subsequent aquatic effects would be reduced across all treated acres. Long-term beneficial impacts of improved riparian condition and instream aquatic habitat from stream restoration would occur.	There would be fewer short-term impacts to aquatic species and habitats from fewer acres of vegetation treatments and temporary roads. Decreased acres of vegetation treatments would equate to less long-term improvement in riparian and watershed condition. The same amount of aquatic restoration and road decommissioning and associated long-term benefits would occur.
Southwestern Region Sensitive Plants	There would be no effects to sensitive plants from management activities because no activities would occur. There would be no restoration activities to address overly dense stands, allowing conditions to move further out of the natural range of variation (NRV) and away from the desired conditions identified for forested areas across the project area. There would be no opportunities to improve the habitat of understory plants including sensitive plants in the project area. There would be no reduction of the risk of uncharacteristic wildfires in the habitats of sensitive plants. Riparian vegetation and habitat would remain in the current state or degrade further over time. There would be no decrease in road density or improvement of riparian condition from decommissioning or relocating roads, precluding opportunities to improve habitat for species such as Bebb's willow or Arizona sneezeweed.	Would move treated areas in the project area closer to NRV and the desired conditions, providing more open stands in some areas which would improve habitat for understory plants including sensitive plants. Would reduce the risk of uncharacteristic wildfire and therefore the risk of habitat damage and potential loss of sensitive plants. Would improve riparian conditions and aquatic habitats and reduce road densities in certain areas of the project, thereby improving the habitat for species such as Bebb's willow and Arizona sneezeweed.	Would reduce the risk of uncharacteristic wildfire, the risk of damage to habitat, and the potential of loss of sensitive plants on fewer acres in the project area than under alternative 2. Would improve riparian conditions and aquatic habitats and reduce road densities in certain areas of the project, thereby improving the habitat for species such as Bebb's willow and Arizona sneezeweed.

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Noxious and Invasive Weeds	Weed infestations that would have been detected by surveys would not occur. Weed treatments would not occur except as part of other projects within the Rim Country project area, or if treated by a cooperating agency.	Vegetation and prescribed burning treatments would limit the establishment and spread of invasive species within and adjacent to the project area over the next several decades by decreasing risk of undesirable fire behavior and effects.	Vegetation and prescribed burning treatments would limit the establishment and spread of invasive species within and adjacent to treated areas over the next several decades by decreasing risk of undesirable fire behavior and effects. With fewer acres being treated, the benefits of limiting the establishment and spread of weeds would be diminished compared to alternative 2.
Cultural Resources	Fuels would continue to accumulate across the project area, including in and around archeological sites. This may result in more frequent and intense wildfires which could cause site and artifact damage such as spalling of rock art and cracking of artifacts. Fire suppression actions, particularly bulldozer operations, may damage or completely destroy surface and subsurface (pit houses/kivas) archaeological sites resulting in the loss of the pit houses and associated resources.	Mechanical thinning on up to 991,060 acres would result in improved protection to cultural resources from the effects of high-severity fires. Ground disturbing treatments have potential to adversely affect cultural resources. Effects could include rutting, erosion, dislocation or breakage of artifacts and features, and destruction of sites and site stratigraphy. Traditional uses of areas or resources by Native American tribes may be affected. These concerns can be addressed through on-going consultation. Rock pit use and expansion have the potential to affect cultural sites adjacent to the pits. These effects would be avoided through coordinated pit expansion design and avoidance measures. Possible unauthorized collection of artifacts may increase near pits but would be mitigated by requiring that sites identified near the pit operation areas are recorded in detail, and monitored. Use of in-woods processing and storage sites would have mitigations in place to limit impacts to cultural resources.	Mechanically thinning on up to 528,850 acres will result in improved protection to cultural resources from the effects of high-severity fires, but less so than in alternative 2. Ground disturbance treatments have potential to adversely affect cultural resources. Effects could include rutting, erosion, dislocation or breakage of artifacts and features and destruction of sites and site stratigraphy. Traditional uses of areas or resources by Native American tribes may be affected. These concerns can be addressed through on-going consultation. Rock Pit use and expansion have the potential to affect cultural sites adjacent to the Pits. These effects would be avoided through coordinated pit expansion design and avoidance measures. Possible unauthorized collection of artifacts may increase near pits but would be mitigated by requiring that sites identified near the pit operation areas are recorded in detail, and monitored. Use of in-woods processing and storage sites would have mitigations in place to limit impacts to cultural resources.

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Socioeconomics	Ongoing projects will continue to provide some amount of socioeconomic benefits with no contribution from the Rim Country Project. There would be no direct project benefits or costs and no economics of scale in forest restoration activities. The three national forests would continue to support local employment and labor income associated with thinning, grazing and recreation at	Up to 5.4 million cubic feet (MMCCF) of products would be produced. There would be avoided costs from reducing the risk of high-severity wildfire and post-fire effects such as flooding and sedimentation. Up to 2,020 jobs and \$86 million in labor income would be expected.	Up to 3.6 MMCCF of products would be produced. There would be avoided costs from reducing the risk of high-severity wildfire and post-fire effects such as flooding and sedimentation. Compared to alternative 2, alternative 3 would treat fewer acres. Focusing treatments on a smaller area could lower the operating costs associated with treatments. Fixed costs associated with site preparation would be lower, site infrastructure needs (e.g., processing, roads) would be reduced, and costs associated with transporting forest products would be lower than under alternative 2. Up to 1,360 jobs and \$58 million in labor income would be expected.
Environmental Justice	The no action alternative would treat the fewest acres with prescribed fire ; however, it would also do the least to restore fire-adapted forests. As a result, smoke from uncharacteristic wildfire is most likely under alternative 1. Minority and low-income residents may experience differential exposure to wildland fire, changes in employment opportunities, or changes in the provision of ecosystem services. Employment or labor income in the project area would not be affected. Therefore, no disproportionate or adverse effects related to changes in economic opportunities would occur as a result of this alternative.	Smoke emissions from prescribed burning would be higher. Smoke emissions from prescribed burns have the advantage over wildfires of being controlled and regulated by the ADEQ in order to protect human health. The action alternatives, through increased treatment acres would do more to restore fire-adapted forests. As a result, smoke from uncharacteristic wildfire is less likely under the action alternatives. The employment and labor income associated with the Rim Country project are expected to have a small, but positive, effect on employment and labor income in minority and low-income communities.	Same as alternative 2

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Recreation	Current management would continue. However, the risk of undesirable fire behavior and effects would not be reduced. This could have negative consequences for recreation values and experiences in affected areas. Developed recreation sites could be adversely affected. Fire-affected areas could be closed to camping. Trails could be closed until repaired. Long-term recreation user displacement and activity substitution behavior could result from negative effects on areas affected by severe wildfires.	Dispersed recreation would not be significantly affected, as there would be many places to camp and recreate. Treatments around the perimeters of campgrounds and other developed sites would protect these areas from the risk of undesirable fire behavior and effects. Trails may be temporarily closed during prescribed burning treatments. After mechanical treatments, trail crossings would be restored to pre-treatment conditions.	Effects would be similar to, but less than those from alternative 2, because fewer acres are proposed for treatment in alternative 3. The acres not treated would retain the same level of wildfire risk as in alternative 1. There would be less short-term recreation user displacement and activity substitution behavior compared to alternative 2 since fewer acres would be treated.
Scenery	In the short term, scenic integrity would remain unchanged. In the long term, if dense stands foster insect outbreaks, increased dwarf mistletoe spread, or other forest health concerns, there is the potential for a reduction in scenic integrity. If stand-replacing wildfire occurs, this would also result in the loss of valued scenic character, as views of a fire-altered landscape may begin to dominate the project area.	In the short term, the scenic integrity would be reduced while project activities (e.g. temporary road construction and reconstruction, rock pits, landings and in-woods processing sites) take place. Scenic integrity should increase once the appearance of slash and ground disturbing activities diminish, roads are rehabilitated, and plant communities respond to the decreased resource competition. In the long term, this alternative would improve the stability of scenic resources by reducing fuel loads and move the project area toward the desired landscape character.	Would have similar effects as those described in alternative 2 except the short-term impacts are expected to be fewer than in alternative 2 due to fewer acres being treated. The acres not proposed for treatment in this alternative would retain the same degree of potential for long-term effects to scenic integrity if insect and mistletoe outbreak and undesirable fire behavior occurs as expected for alternative 1. Since high-severity fire is a risk factor for most scenery attributes, the smaller area of proposed mechanical and prescribed fire treatments would result in fewer improvements to scenic quality in the long term compared to alternative 2.
Lands and Minerals	Fuel loading would continue to increase across the project area, increasing the risk of undesirable fire behavior and effects, and leaving the area less resilient to disturbance. Severe wildfire could affect lands special uses by threatening structures and infrastructure they authorize in both the short term (10 years) and long term (beyond 20 years). Infrastructure associated with active minerals sites would also be similarly threatened.	Implementation would result in lower risk of undesirable fire behavior across the treated area, which would reduce the threat to the infrastructure and structures whose use are authorized under lands special use, and mineral permits. Short-term impacts to lands special uses and mineral projects could occur as restoration activities are implemented. Potential negative effects would be minimized through notifications of and coordination with permit holders.	Implementation would result in lower risk of undesirable fire behavior across the treated area, which would reduce the threat to the infrastructure and structures whose use are authorized under lands special use, and mineral permits. Permitted uses and infrastructure outside of treated areas would continue to be at risk from severe wildfire. Short-term impacts to lands special uses and mineral projects could occur as restoration activities are implemented, although potential disruptions would occur across fewer acres relative to alternative 2. Potential negative effects would be minimized through notifications of and coordination with permit holder.

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Tribal Relations	The risk of undesirable fire behavior and effects would not be reduced. Severe wildfire in untreated areas could result in impacts to Traditional Cultural Properties (TCPs) including loss of traditionally important native plant species and continued loss of culturally important springs due to decreased ground water recharge and availability.	Within treated areas, ground disturbing activities that could impact traditional collecting, gathering and ceremonial uses areas and TCPs would increase in the short term. Project implementation schedules may impact some American Indian uses as tribal members commonly access forest lands for ceremonial activities and to gather forest products and, in some cases, the timing of these activities are related to ceremonies or the seasonality of some plant species. Increases in prescribed fire in all action alternatives, except no action, create the potential for increased smoke impacts to tribal communities. Possible road decommissioning can assist in limiting access to some sensitive tribal areas such as shrines and traditional gathering areas. However, this may have the unintended consequence of impending tribal elders from accessing these areas as well. All of these effects can be mitigated through continuous communication and consultation with tribal communities.	From a tribal relations stand point, the effects for this alternative are the same as alternative 2.
Range	With no additional treatments, high tree densities would continue to suppress understory vegetation. In the short-term, no changes to livestock management would be needed but, over time, as forage production continues to decline, reductions in grazing capacity would occur.	Proposed thinning and prescribed fire would reduce tree densities, allowing for the greatest amount of understory vegetation production of all the alternatives. Short-term adjustments to pasture rotations may be needed but, in the long term, this alternative would result in the greatest increase the forage production.	Proposed thinning and prescribed fire would reduce tree densities, allowing for understory vegetation production, but on fewer acres than in alternative 2. Short-term adjustments to pasture rotations may be needed, but fewer than in alternative 2. The long-term forage production and grazing capacity would increase, but there would be less improvement than in alternative 2.

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Transportation	No new restoration activities would take place and no additional use of existing roads would occur. Current rates of public and administrative use would continue. Maintenance to provide public and administrative access would continue, contingent upon funding. No increase in road maintenance to accommodate restoration activities would occur. No road decommissioning would occur within the project area unless it is analyzed under separate NEPA analysis. No new temporary roads would be constructed, unless under separate NEPA analysis. No effects from in-woods processing and storage sites.	Nearly all, if not all system roads within the project area could be utilized at some point in implementation. Roads that would be used would likely see pre-haul maintenance or reconstruction if needed and continued maintenance during implementation. This maintenance would be in addition to regularly scheduled maintenance. Up to 200 miles of system roads would be decommissioned on the Coconino National Forest and the Apache-Sitgreaves National Forest. Approximately 290 miles of system roads on the Tonto National Forest would be decommissioned, and approximately 800 miles of unauthorized roads on all three forests may be decommissioned. Up to 330 miles of temporary road would be constructed and decommissioned after use. Construction of temporary roads would expand the existing transportation system within the project area to provide adequate access to all stands in need of mechanical treatment. Construction of temporary roads would allow nearly all stands to be harvested with a maximum skidding distance of 1,250' or less". Temporary roads can also be used for access for prescribe fire and other restoration activities. In-woods processing and storage sites could require a limited amount of temporary road. This mileage is included in the overall estimated temporary road mileage for the alternative.	Nearly all, if not all system roads within the project area could be utilized at some point in implementation. Roads that would be used would likely see pre-haul maintenance or reconstruction if needed and continued maintenance during implementation. This maintenance would be in addition regularly scheduled maintenance. Up to 200 miles of system roads would be decommissioned on the Coconino National Forest and the Apache-Sitgreaves National Forest. Approximately 290 miles of system roads on the Tonto National Forest would be decommissioned, and approximately 800 miles of unauthorized roads on all three forests may be decommissioned. Up to 170 miles of temporary road would be constructed and decommissioned after use. Construction of temporary roads would expand the existing transportation system within the project area to provide adequate access to all stands in need of mechanical treatment. Construction of temporary roads would allow nearly all stands to be harvested with a maximum skidding distance of 1,250' or less". Temporary roads can also be used for access for prescribe fire and other restoration activities. In-woods processing and storage sites could require a limited amount of temporary road. This mileage is included in the overall estimated temporary road mileage road mileage for the alternative.

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Inventoried Roadless Areas	No IRAs would be treated under this alternative. There could be potential negative impacts to the characteristics 1, 3, 4, 5, and 7 from not addressing the existing stand conditions within the IRAs, specifically the increased risk of uncharacteristic wildfire.	Alternative 2 would treat 7,298 acres for mechanical timber harvest and prescribed fire. This alternative would maintain characteristics 5, 7, 8, and 9. Characteristics 1, 2, 3, and 4 would be improved. The proposed activities would help preserve the natural appearing character of the landscape. Treatments would promote resiliency in forested areas during wildfires by reducing the potential for high-severity fire behavior within IRAs. The inventoried roadless character would be protected and possibly enhanced.	Alternative 3 would have similar effects as those described in alternative 2 except to a lesser extent because fewer acres would be treated. Alternative 3 would treat 1,757 acres with mechanical timber harvest and prescribed fire.

Chapter 3. Affected Environment and Environmental Consequences

This chapter summarizes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on those environments. It presents the assumptions and methodologies used to analyze the effects of the alternatives, which are the scientific and analytical basis for comparing the alternatives. Only summaries are provided here for each resource area. All specialist reports in their entirety are incorporated by reference and are available on the 4FRI Rim Country webpage at: www.fs.usda.gov/goto/4FRIRimCountry.

Assumptions and Methodology

To facilitate landscape analysis and strategic planning in the Southwest, the Forest Service has developed a framework of ecosystem types referred to as ecological response units (ERUs). In the Southwestern Region of the Forest Service, these ERUs provide the foundational unit for analysis of vegetative attributes and associated ecosystem services at the landscape and strategic planning scales (USDA Forest Service 2017). Reference conditions and desired conditions are described for each ecological response unit. The desired conditions correspond with the final regional vegetation desired conditions that are carried forward in Land Management Plans revised after this framework was developed. Of the three Land Management Plans tiered to in the Rim Country EIS, only the 2018 Coconino Revised Land Management Plan used ERUs. The 2015 Apache-Sitgreaves Revised Land Management Plan used Potential Natural Vegetation Types (PNVTs) in its analysis, and the 1996 amendment to the Tonto Land Management Plan incorporated the earlier Terrestrial Ecological Unit Inventory (TEUI).

The forest cover types used for the Rim Country analysis are based on the Ecological Response Units (ERUs) identified in the project area. Ecological Response Units represent an ecosystem stratification based on vegetation characteristics that would occur when natural disturbance regimes and biological processes prevail and combine potential vegetation and historic fire regimes to form ecosystem classes useful for landscape assessment (Wahlberg 2014). Ecological Response Units are the next derivation based on the concepts developed for PNVTs. Ecological Response Units incorporate more information concerning fire and its role in the ecosystem. For the purposes of the Rim Country Project EIS analysis PNVTs and ERUs are considered equivalent and the term ERUs will be used throughout.

For some resource areas or at certain scales, the analysis presented may include classifications of forest cover types other than ERUs. For example, analysis of the effects of proposed treatments on vegetation at the fine- to mid-scale may discuss the existing vegetation type or existing condition (EC) in terms of cover types (such as ponderosa pine/Gambel cover type) that were derived from data collected as part of Common Stand Exams performed within the project area. Each resource area's section of chapter 3 discusses the resource-specific assumptions and methodologies used for analysis, including cover types where relevant.

Each resource specialist determined what ecological units and subunits would be best for their effects analysis. Most specialists use watersheds as their landscape-scale analysis units, while the finer-scale analysis units differ by resource area. The analysis units used for each resource area are described in the Assumptions and Methodology section of each specialist report and summarized here for each individual resource area. Due to differences in specialists' approaches to rounding when displaying numerical data, sums of table columns may differ slightly from the totals displayed.

Effects Analysis

For the action alternatives, the Rim Country FEIS includes analysis of the potential direct, indirect, and cumulative effects from treating the number of acres proposed for each specific treatment toward the lower end of the target basal area range for that treatment. For example, the uneven-aged-moderate site treatment (UEA-Moderate) has a post-treatment basal area range of 45 to 75 square feet of basal area per acre and would be analyzed closer to the lower end of that range. See Appendix D. Implementation Plan for more information on the post-treatment basal area of proposed treatments. This level of examination is done to ensure that the maximum potential effects from the activities proposed in each action alternative are analyzed, even though it may give the appearance of more pronounced effects than expected. A stand treatment adjusted to a lower intensity during implementation, per the condition-based management approach used for this project, may have fewer effects on the environment, depending on the affected resource, than the more open treatments originally proposed for that stand, resulting in less effects than those analyzed in the FEIS.

Cumulative Effects

Included below are a map of the Rim Country project area and 6th HUC watersheds (figure 17) for cumulative effects analysis area, summary of past, present, and reasonably foreseeable projects with management activities proposed and completed (see table 28), and past wildfires (see table 29 and figure 18). This summary is intended to provide a snapshot of those projects and events that have influenced the existing conditions (in terms of vegetation structure, composition, diversity and function). It also represents the best available information made available to each resource specialist to determine relevance to their specific resource. Each resource specialist identified the cumulative effects analysis boundary and past, present and reasonably foreseeable projects relevant to their specific resource and used this information, along with the potential direct and indirect effects of the proposed alternatives, to analyze the cumulative effects on their resource area. Cumulative effects analyses are discussed in this chapter by resource area.

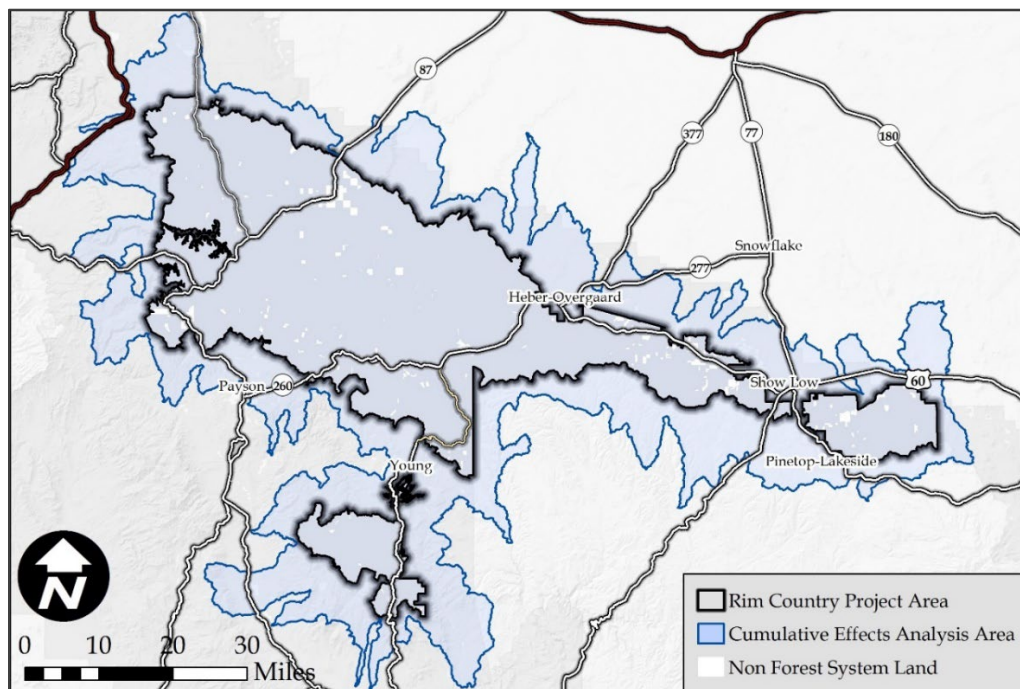


Figure 17. Cumulative effects analysis area for resources that used HUC 6 watersheds

Table 28. Past, current, and reasonably foreseeable projects

Project Name	NEPA Decision Year	Treatment Types	Acres <u>Planned</u> Mechanical/ Prescribed Fire/Other	Acres <u>Implemented</u> Mechanical/ Prescribed Fire /Other ⁵	Forest	Past	Current	Reasonably Foreseeable
Vegetation Management Projects (Mechanical Thinning and Prescribed Fire)								
Mullen Saw timber and Whitcom Multiproduct Offerings	1990	Group selection, intermediate thin, pre-commercial thin, shelterwood seed cut	Mullen: 1,798/0/0 Whitcom: 1,440/0/0	0 /130/685 wildlife habitat improvement	Apache-Sitgreaves	YES	NO	NO
Jersey Horse Timber Sale	1991	Species habitat improvements, timber sales, forest vegetation improvements, fuel treatments	N/A	1,452/351/0	Apache-Sitgreaves	YES	NO	NO
Amended Elk Timber Sale	1993	Commercial and pre-commercial mechanical thinning	2,589/0/0	834/466/0	Apache-Sitgreaves	YES	NO	NO
Brookbank Multi-Product Timber Sale	1994	Mechanical thinning and prescribed fire	6,177/6,465/0	5,624/4,981/0	Apache-Sitgreaves	YES	NO	NO
Cottonwood Wash Ecosystem Management Area	1995	Mechanical thinning, fuelwood sales, prescribed fire	3,493/10,896/0	516/2,447/0	Apache-Sitgreaves	YES	NO	NO
Blue Ridge-Morgan	1997	Commercial mechanical thinning, fuelwood sales, broadcast burning	8,280/7,618/0	14,471/14,552/0	Apache-Sitgreaves	YES	NO	NO
Gentry	1997	Thinning, fire	7,718	451/191/ 0	Apache-Sitgreaves	YES	NO	NO
Sundown Ecosystem Management Area	1997	Salvage cut intermediate treatment, regen, fire	7,607	2,075/24/170 range vegetation control, 1,830 range veg manipulation and type conversion, 3,463 tree encroachment control, 1,560 tree release and weed	Apache-Sitgreaves	YES	NO	NO
Wiggins Analysis Area	1998	Group selection, intermediate thinning, pre-commercial thinning, broadcast burning	5,935/3,385	0/4,224/0	Apache-Sitgreaves	YES	NO	NO

⁵ Acres of implementation may be counted more than once for multiple activities on the same acres.

Project Name	NEPA Decision Year	Treatment Types	Acres <u>Planned</u> Mechanical/ Prescribed Fire/Other	Acres <u>Implemented</u> Mechanical/ Prescribed Fire /Other ⁵	Forest	Past	Current	Reasonably Foreseeable
Show Low South (#22297)	1999	Prescribed fire, construction/ maintenance of defensible space	N/A	0/2,696/0	Apache-Sitgreaves	YES	NO	NO
Larson Prescribed Burn	2001	Prescribed fire	0/2,500/0	0/3,015/0	Apache-Sitgreaves	YES	NO	NO
Treatment of Dead Trees in the Rodeo-Chediski Fire (#20740)	2002	Treat dead trees for trail management, facility and road maintenance, utility line safety	N/A	5,730/1,880/15 fuels compaction	Apache-Sitgreaves	YES	NO	NO
Heber-Overgaard WUI	2003	Mechanical thinning, prescribed fire	3,593/489/0	5,089/686/571 fuels chipping, 541 range forage improvement, 96 special products removal	Apache-Sitgreaves	YES	NO	NO
Hidden Lake Prescribed Burn	2003	Prescribed fire	0/2,000/0	0/2,828/0	Apache-Sitgreaves	YES	NO	NO
Camp Tatiyee / Camp Grace Fuel Reduction	2004	Pile Burning	340/340/0	0/172/0	Apache-Sitgreaves	YES	NO	NO
Country Club Escape Route	2004	Commercial thinning, fire	0/975/0	524/1,848 burning/915 range cover manipulation	Apache-Sitgreaves	YES	NO	NO
High Value Ponderosa Pine Tree Protection	2004	Mechanical thinning, insecticide treatment	698/0/698	985/826/203 insect control and prevention	Apache-Sitgreaves	YES	NO	NO
Rodeo-Chediski Fire Salvage	2004	Mechanical thinning, fuel treatments	47,467/0/0	25,913/ 626/1,256 fuel breaks, 411 planting/ regeneration site prep	Apache-Sitgreaves	YES	NO	NO
Forest Lakes WUI Treatment	2005	Mechanical thinning, hand thinning, piling, pile burning	N/A	1,691/1,645/0	Apache-Sitgreaves	YES	NO	NO
Rim Top Prescribed Burn (formerly Woods Canyon Fuel Treatment)	2005	Prescribed fire	0/665/0	0/665/0	Apache-Sitgreaves	YES	NO	NO
Show Low South (#4456)	2005	Thinning, fuels treatments	N/A	10/585/0	Apache-Sitgreaves	YES	NO	NO
Dye Thinning	2006	Mechanical thinning	250/250/0	247/0/0	Apache-Sitgreaves	YES	NO	NO

Project Name	NEPA Decision Year	Treatment Types	Acres <u>Planned</u> Mechanical/ Prescribed Fire/Other	Acres <u>Implemented</u> Mechanical/ Prescribed Fire /Other ⁵	Forest	Past	Current	Reasonably Foreseeable
Hilltop WUI	2006	Mechanical thinning, mastication, prescribed fire	1,544/1,544/0	1,534/45/616 range forage improvement	Apache-Sitgreaves	YES	NO	NO
Bruno Thinning and Slash	2009	Hand thinning, piling, pile burning	0/86/0	0/70/0	Apache-Sitgreaves	YES	NO	NO
Whitcom WUI	2009	Commercial thinning, fire	0	925/0/0	Apache-Sitgreaves	YES	NO	NO
Hilltop II Fuels Reduction	2011	Mechanical thinning, prescribed fire	190/1,544/0	0/799/616 cultural site protection	Apache-Sitgreaves	YES	NO	NO
Little Springs WUI	2003	Group selection, improvement cut, commercial thin	7,991/0/0	4,376/4,227/ 2,500 range cover manipulation	Apache-Sitgreaves	NO	YES	NO
Nagel	2005	Commercial thin, salvage cut, fire	116,618	19,611/18,231/ 889 range cover manipulation, 1,592 range forage improvement, 321 scarify and seed landings	Apache-Sitgreaves	NO	YES	NO
Los Burros	2006	WUI thinning, hazardous fuels treatments, woodland stand thinning, thin from below, aspen regeneration treatments	22,224/3,560/0	30,237/13,059/ 29 range cover manipulation	Apache-Sitgreaves	NO	YES	NO
Nutrioso WUI	2006	Commercial thin, salvage cut, fire	28,576/39,356/0	19,476/9,870/ 827 tree planting, 394 control range vegetation, 33 control tree encroachment	Apache-Sitgreaves	NO	YES	NO
Show Low South (#29987)	2011	Commercial thin, group selection, fire	3,739/4,637/0	3,372/0/0	Apache-Sitgreaves	NO	YES	NO
Rodeo-Chediski Fire Prescribed Burn	2012	Fire, pruning, limbing	0/148,222/0	0/9,506/9,670 range cover manipulation, 5,162 weed & tree release	Apache-Sitgreaves	NO	YES	NO
Timber Mesa/Vernon WUI	2012	Single tree and group selection, commercial thinning, fire	27,000/as needed/0	18,781/39,760/ 9,911 range cover manipulation, 3,979 control tree encroachment, 6,551 weed & tree release	Apache-Sitgreaves	NO	YES	NO
Rim Lakes Forest Restoration	2013	Selection cut, broadcast burn	23,671/32,954/0	12,483/1,335/ 116 pruning, 6,251 range cover manipulation, 80 weed & tree release	Apache-Sitgreaves	NO	YES	NO

Project Name	NEPA Decision Year	Treatment Types	Acres Planned Mechanical/ Prescribed Fire/Other	Acres Implemented Mechanical/ Prescribed Fire /Other ⁵	Forest	Past	Current	Reasonably Foreseeable
Larson Forest Restoration	2015	Group selection, intermediate thinning, pre-commercial thin, shelterwood seed cut, broadcast burn	25,726/4,906/0	1,867/0/2,513 range cover manipulation, 3 weed & tree release	Apache-Sitgreaves	NO	YES	NO
Upper Rocky Arroyo Restoration	2016	Mechanical thinning, hand thinning, fire	30,400/as needed/0	696/5,411/ 3,960 wildlife habitat improvement	Apache-Sitgreaves	NO	YES	NO
Section 31 Fuels Reduction	2017	Mechanical thinning	230/0/0	44/0/0	Apache-Sitgreaves	NO	YES	NO
Rodeo-Chediski Mastication (Heber-Overgaard and Ricochet/ Williams Ranch Fuels Reduction)	2018	Mastication, removal of small trees, piling & burning	285/285/0	285/0/0	Apache-Sitgreaves	NO	YES	NO
Pocket Baker	2000	Mechanical treatment, prescribed fire	5,200/17,000/0	0/5,450/0	Coconino	YES	NO	NO
Blue Ridge Urban Interface	2001	Pre-commercial thinning, prescribed fire	8,158/10,549/0	416/6,225/ 2325 control range vegetation	Coconino	YES	NO	NO
IMAX	2002	Pre-commercial thin and lop Pre-commercial thin, pile, and burn	786/18	0/6,008/0	Coconino	YES	NO	NO
Pack Rat Salvage	2004	Salvage, thinning, pile burning	550/550/0	550/0/0	Coconino	YES	NO	NO
Bald Mesa Fuels Reduction	2005	Mechanical treatment, prescribed fire, fuels reduction	N/A	2,485/5,150/0	Coconino	YES	NO	NO
APS Blue Ridge 69kV Transmission Line	2005	Mechanical treatment, prescribed fire	N/A	0/1,600/0	Coconino	YES	NO	NO
Good/Tule	2006	Thinning, prescribed fire	4,337/8,361/0	1,389/2,025/0	Coconino	YES	NO	NO
Post-Tornado Resource Protection and Recovery	2011	Removing downed wood, thinning	14,776/3,990/0	765/0/0	Coconino	YES	NO	NO
Lake Mary Road ROW Clearing (ADOT)	2016	Clearing the right-of-way of ponderosa pine trees	N/A	788/0/0	Coconino	YES	NO	NO

Project Name	NEPA Decision Year	Treatment Types	Acres Planned Mechanical/ Prescribed Fire/Other	Acres Implemented Mechanical/ Prescribed Fire /Other ⁵	Forest	Past	Current	Reasonably Foreseeable
Lake Mary Meadows Two Fuel Reduction	2005	Thinning encroachment conifers and prescribed fire	300/0/0	117/10,223/ 803 control range vegetation	Coconino	NO	YES	NO
East Clear Creek Watershed Health Improvement	2006	Mechanical treatment, prescribed fire	10,407/10,497/0	40,020/38,470/ 30,000 weed & tree release, 10,000 control tree encroachment	Coconino	NO	YES	NO
Victorine 10K Area Analysis	2006	Mechanical thinning, prescribed fire	1,293/8,407/0	9,015/29,585/0	Coconino	YES	YES	NO
Upper Beaver Creek Watershed Fuel Reduction	2010	Mechanical thinning, prescribed fire	15,807/75,068/0	20,608/64,000/0	Coconino	NO	YES	NO
Blue Ridge Community Fire Risk Reduction	2012	Mechanical, pile burning	50-75/5/0	0/45,000/0	Coconino	NO	YES	NO
Clints Well Forest Restoration	2013	Mechanical thinning, prescribed fire	12,899/16,444/ 25 rock pit expansion	11/6,639/0	Coconino	NO	YES	NO
Hutch Mountain Communication Site	2017	Clearing for communication site and solar array, thinning	2.5/0/0	0.5/0/0	Coconino	NO	YES	NO
Cragin WPP	2018	Mechanical thinning, prescribed fire	41,046/63,656/0	0/0/0	Coconino	NO	NO	YES
Hwy 87 tree thinning	2015	Removal of potentially hazardous trees and shrubs throughout the ROW	29 miles of ROW	29 miles of ROW	Coconino/ Tonto	YES	NO	NO
Mogollon Rim Christmas Tree Cutting	2008, 2013, 2014	Removal of young fir, spruce, and pine trees	9,800 acres	Approximately 600 permits issued/year across the 9,800 acres	Coconino	YES	NO	NO
Buck Mountain Lookout Tower Viewshed Project	2017	Thinning to 40 BA	42	0/0/0	Coconino	YES	NO	NO
Ridge Analysis Area	1994	Commercial thinning, salvage, vegetation improvements, hazardous fuels reduction	N/A	33,311/0/1,094 control range vegetation	Tonto	YES	NO	NO

Project Name	NEPA Decision Year	Treatment Types	Acres <u>Planned</u> Mechanical/ Prescribed Fire/Other	Acres <u>Implemented</u> Mechanical/ Prescribed Fire /Other ⁵	Forest	Past	Current	Reasonably Foreseeable
Lion Analysis Area	2001	Intermediate thinning, prep cutting, uneven-aged management, wildlife forage areas, prescribed burning	2,455/9,000-10,000/0	5,664/6,900/ 664 weed & tree release	Tonto	YES	NO	NO
Shoofly	2009	Thinning, broadcast burning	1,733	114/0	Tonto	YES	NO	NO
Manaco	1994	Thinning	4,129/6,500	628/0/0	Tonto	YES	NO	NO
Bull Owl	1993	Thinning, broadcast burning,	5,571/5,779	79/418/0	Tonto	YES	NO	NO
Verde WUI	2004	Thinning, PJ savanna restoration, fuel break construction, prescribed burning	15,471/28,438/1,401 PJ savanna restoration	10,648/48,500/ 5,000 range cover manipulation	Tonto	YES	NO	NO
Payson WUI	2004	Broadcast burning, pile burning, thin from below, fuel breaks	35,037	8,848/4,144/0	Tonto	YES	YES	YES
Parallel Prescribed Burn	2014	Prescribed fire	0/24,089/0	0/4,759/0	Tonto	YES	YES	YES
Pine-Strawberry WUI	2006	Thinning, grassland restoration, fuel break construction, prescribed fire	9,709/40,928/ 7,525 grassland restoration	41,086/19,868/ 200 range cover manipulation	Tonto	NO	YES	YES
Chamberlain Analysis Area	2008	Mechanical thinning, prescribed burning, shaded fuel breaks	8,072/20,050/0	9,044/19,000/ 1,675 control range vegetation	Tonto	NO	YES	YES
Christopher/Hunter WUI	2009	Thinning, fuel break construction, prescribed burning	32,358/20,550/0	10,763/19,000/ 450 weed & tree release, 489 control range vegetation	Tonto	NO	YES	YES
Cherry Prescribed Burn	2012	Prescribed burning	0/14,700 – 21,000/0	0/6,582/0	Tonto	NO	NO	NO
Myrtle WUI	2012	Fuel breaks, thinning, prescribed fire	16,702/27,131/0	103,891/75,800/1,091 weed & tree release, 744 control range vegetation	Tonto	NO	YES	NO
Spring CE	2018	Prescribed burning, Juniper Piles	213,013	17,084/1,578/0	Tonto	YES	YES	YES
Flying V&H Prescribed Fire	Decision expected 2021	Prescribed burning, shaded fuel breaks	1,798/59,124/0	0/0/0	Tonto	NO	NO	YES

Project Name	NEPA Decision Year	Treatment Types	Acres <u>Planned</u> Mechanical/ Prescribed Fire/Other	Acres <u>Implemented</u> Mechanical/ Prescribed Fire /Other ⁵	Forest	Past	Current	Reasonably Foreseeable
Right-of-Way (ROW) Projects with Herbicide Use								
Management of Noxious Weeds and Hazardous Vegetation on State Highway ROWs	2004	Herbicide treatment of noxious <u>or invasive</u> weeds and hazardous vegetation	N/A	25/0/ 11,005 pesticide control of noxious or invasive weeds and hazardous vegetation	Tonto	YES	NO	NO
APS-Herbicide Use within Authorized Power Line ROWs on NFS Lands in AZ	2019	Herbicide treatment	0/0/ 2,136 herbicide application	0/0/0	Apache-Sitgreaves Coconino Tonto	NO	<u>YES</u>	YES
WAPA Glen Canyon-Rogers 230/345kV Integrated Vegetation Management	Decision expected 2022	Herbicide treatment	13,338/0/0	0/0/0	Coconino Tonto	NO	NO	YES
SRP-Herbicide Use within Authorized Power Line ROWs on NFS Lands in AZ	Decision expected 2021	Herbicide treatment	0/0/ 7,469 herbicide application	0/0/0	Apache-Sitgreaves Tonto	NO	NO	YES
Wildlife Habitat Improvement, Grassland Restoration Projects/Allotment Projects								
Park Day Allotment	1994	Mechanical and hand thinning, fuelwood sales, broadcast burning	14,665/250/0	2,193/0/ 701 control range vegetation	Apache-Sitgreaves	YES	NO	NO
Clear Creek Allotment	2000	Species habitat improvement, rangeland vegetation improvement	108	2,397/0/ 949 control tree encroachment, 2,288 range cover manipulation	Apache-Sitgreaves	YES	NO	NO
Wallace Allotment	<u>2000</u>	<u>Rangeland vegetation improvement</u>	<u>N/A</u>	0/0/ 1,586 control tree encroachment, 161 control understory vegetation	Apache-Sitgreaves	YES	NO	NO
Railroad Allotment (Formerly Carlisle Complex Vegetation Treatments)	2007	Mechanical juniper removal	10,000/0/0	2,873/0/ 561 control tree encroachment	Apache-Sitgreaves	NO	YES	NO

Project Name	NEPA Decision Year	Treatment Types	Acres Planned Mechanical/ Prescribed Fire/Other	Acres Implemented Mechanical/ Prescribed Fire /Other ⁵	Forest	Past	Current	Reasonably Foreseeable
Williams Ranch Mastication	2018	Mastication and fuelwood entries	300	300	Apache-Sitgreaves	YES	NO	NO
Heber Allotment	2020	Mechanical thinning, prescribed fire	0/0/39,000 grassland restoration	0/0/0	Apache-Sitgreaves	NO	NO	YES
Apache Maid Grassland Restoration	2004	Lop and scatter of pine and juniper, prescribed fire	4,528/14,200/0	54,528/6,770/0	Coconino	YES	NO	NO
Bar T Bar/Anderson Springs Allotment	2005	Meadow, grassland, wildlife corridor restoration treatment; prescribed fire	32,677/32,677/0	1,304/132,938/1,519 control range vegetation, 39,180 control tree encroachment, 652 wildlife habitat improvement	Coconino	NO	YES	NO
Hardscrabble Allotment Juniper Clearing		Cut juniper trees	100/0/0	0/0/0	Tonto	NO	NO	YES
Bar X and Sheep Driveway Grazing EA	2019	Fence construction, Construct earthen Stock tanks	N/A	0/0/0	Tonto	YES	NO	NO
Pleasant Valley Northwest Grazing Allotments		Fence construction, juniper removal	N/A	0/0/0	Tonto	NO	NO	YES
Red Lake Tanks	2017	Tank construction, shrub removal	0/0/0.8 acres dredging, berm construction, ditch excavation	0/0/0	Tonto	YES	NO	NO
Red Lake Juniper Push	2016	Juniper Removal	40 ac	N/A	Tonto	YES	NO	NO
Bar X Tanks	2017	Tank Construction	N/A	N/A	Tonto	YES	NO	NO
Diamond Rim Water Catchment Replacement Project	2017	Water Catchment Restoration	N/A	N/A	Tonto	YES	NO	No
Sycamore Canyon and Pigeon Wildlife Catchment Replacement Project	2020	Wildlife Catchment Restoration	N/A	N/A	Tonto	No	Yes	No
Cherry Creek and Frio Canyon Allotment	2009	Juniper thinning, burning	3,250	1,979/677/0	Tonto	YES	YES	NO

Project Name	NEPA Decision Year	Treatment Types	Acres <u>Planned</u> Mechanical/ Prescribed Fire/Other	Acres <u>Implemented</u> Mechanical/ Prescribed Fire /Other ⁵	Forest	Past	Current	Reasonably Foreseeable
Buzzard Roost Allotment Analysis	2007	Thinning	N/A	623/0/0	Tonto	YES	NO	NO
East Verde River Restoration Project	2018	Channel Stabilization and Restoration	N/A	N/A	Tonto	YES	NO	NO
Reforestation/Planting Projects								
Bison Reforestation	2003	Site prep, planting	0/0/500	356/312/ 308 tree planting, 275 animal damage control	Apache-Sitgreaves	YES	NO	NO
Clay Springs Reforestation	2004	Site prep, planting	0/0/710	0/0/0 169 tree planting, 169 animal damage control	Apache-Sitgreaves	YES	NO	NO
Jacques Marsh Elk Proof Fence & Riparian Planting	2006	Exclosure, planting	0/0/10	0/73/0	Apache-Sitgreaves	YES	NO	NO
Pierce Reforestation	2009	Site prep, planting	0/0/1,375	0/0/ 203 tree planting, 203 animal damage control	Apache-Sitgreaves	YES	NO	NO
Rodeo-Chediski Riparian Planting	2010	Planting	0/0/ 1 tree planting	0/0/ 0.6 tree planting	Apache-Sitgreaves	YES	NO	NO
Rodeo-Chediski Reforestation (#18675)	2007	Planting, shade installation, fencing	0/0/3,071	0/150/ 551 tree planting, 303 animal damage control, 202 weed & tree release	Apache-Sitgreaves	NO	YES	NO
AGFD Fairchild Draw Elk Exclosure	2018	Maintain fence	0/0/ 16 fence maintenance	0/0/0	Apache-Sitgreaves	NO	NO	YES
Yarrow Reforestation	2020	Mastication and planting	500/0/710 planting	0/0/0	Apache-Sitgreaves	NO	YES	YES
Ross Draw Tree Removal	Decision Expected in 2021	Mastication and planting	4000/0/0	0/0/0	Apache-Sitgreaves	NO	NO	YES
Rim Lakes Recreation Area Brood Tree Removal	Decision Expected in 2021	Mastication	200/0/0	0/0/0	Apache-Sitgreaves	NO	NO	YES
Conifer Weeding for Aspen Enclosure	Unknown	N/A	N/A	65/0/0	Coconino	YES	NO	NO

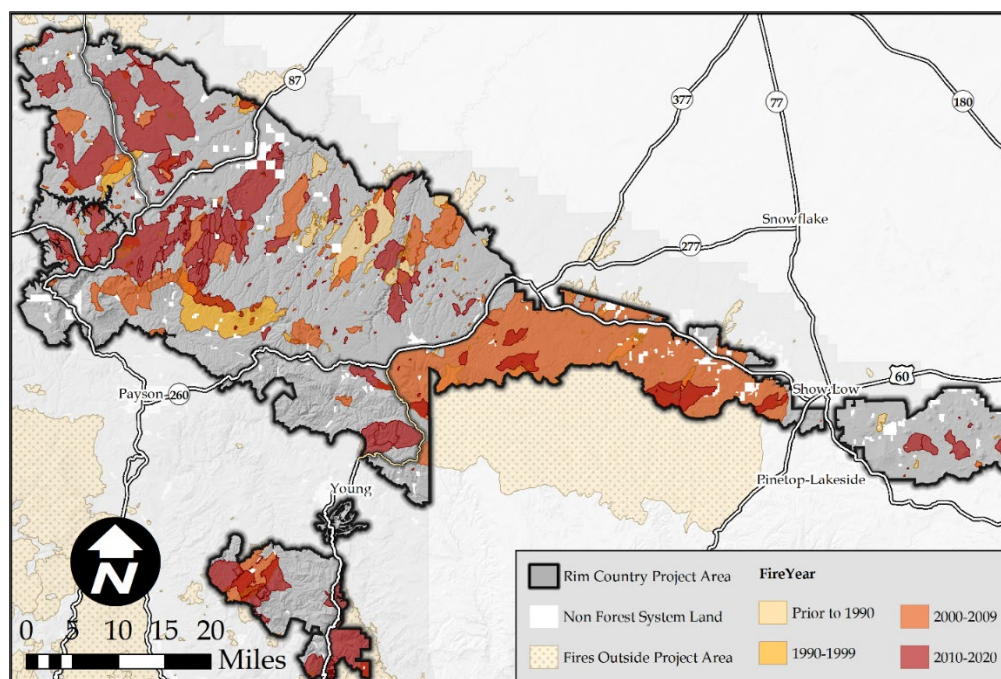
Project Name	NEPA Decision Year	Treatment Types	Acres <u>Planned</u> Mechanical/ Prescribed Fire/Other	Acres <u>Implemented</u> Mechanical/ Prescribed Fire /Other ⁵	Forest	Past	Current	Reasonably Foreseeable
Colcord Campground Planting	2008	Planting	20	0	Tonto	NO	YES	NO
Spring and Meadow Restoration Projects								
Bill Dick, Foster, and Jones Springs Enhancement	2013	Pond and trough installation, fence installation and maintenance, willow pole planting	0/0/9.3	Bill Dick spring: fencing and pool enhancement completed Jones spring: boulders placed around the spring instead of fencing completed	Coconino	YES	NO	NO
Allan Lake Wetland Restoration Project	2014	Restore channels, cover bottom with clay, revegetation of disturbed areas	17	17	Coconino	YES	NO	NO
Long Valley Work Center Meadow Restoration	2018	Channel reconstruction, tree removal, pond removal, install erosion control matting	0/0/30	Some channel restoration and erosion and tree encroachment control has been implemented	Coconino	NO	YES	NO
East Clear Creek Watershed Health Improvement	2006	Meadow thinning, culvert raising to increase water retention at up to 5 springs.	5 springs, 330 acres meadow thinning	Some channel restoration and erosion and tree encroachment control has been implemented	Coconino	YES	YES	NO
Little Green Valley Fen Restoration	2017	Elk and Cattle fence. Channel redesign	N/A	N/A	Tonto	NO	YES	NO
Other Projects								
Activities reported in FACTS for which NEPA decision field was unpopulated	Unknown	Tree planting and replanting, site prep, animal damage control, invasives control, control range vegetation, range cover manipulation, seeding and plating, tree encroachment control, weed & release, habitat improvement.	N/A	42,763/74,202/ 2,158 tree planting, 350 replant trees, 1,720 site prep, 59 animal damage control, 82 invasives control, 497 control range vegetation; 4,297 range cover manipulation, 438 seeding and planting, 5,563 control tree encroachment, 27 weed & tree release, 1,465 habitat improvement	Apache-Sitgreaves	NO	YES	NO
Four Springs Trail Realignment	Decision expected 2018	Trail reroute and rehabilitation	0/0/4.5 miles	0/0/0	Apache-Sitgreaves	NO	NO	YES
Travel Management	Decision Expected 2022	Designation of routes and areas for motor vehicle use	N/A	All	Coconino	YES	YES	NO

Project Name	NEPA Decision Year	Treatment Types	Acres <u>Planned</u> Mechanical/ Prescribed Fire/Other	Acres <u>Implemented</u> Mechanical/ Prescribed Fire /Other ⁵	Forest	Past	Current	Reasonably Foreseeable
Grapevine Interconnect (Grapevine Canyon Wind Project)	2012	Installation of powerline and switchyard	24/0/0	Not implemented to date	Coconino	YES	NO	NO
APS Line Maintenance	2019	Right-of-way vegetation maintenance and herbicide application	-2,024.35/0/0	87/0/0	Coconino	YES	NO	NO
Sixteen Rock Pits and Additional Reclamation	2017	Expansion and reclamation of rock pits	66/0/ 66 excavation, 5 re-contouring, 5 planting	0/0/0	Coconino	NO	YES	NO
Glen Canyon-Pinnacle Peak 345kV Transmission Line Vegetation Management (WAPA)	2014	Mechanical vegetation removal	4,580/0/0	Ongoing vegetation maintenance program being implemented since 2014	Coconino	NO	YES	NO
Houston Draw Aquatic Organism Project	2010	Stabilizing and restoring stream channel, culvert replacement	~ 1,000 feet of stream channel	Fully implemented	Coconino	YES	NO	NO
Integrated Treatment of Noxious or Invasive Weeds	2004	Authorizes mechanical, biological, cultural, and chemical removal of weeds	31,047	16,049/15,175/ 15 biocontrol of invasive species, 20 pesticide control of invasive species, 3,921 control range vegetation, 739 weed & tree release	Coconino (Kaibab and Prescott too)	YES	YES	YES
Travel Management	2011	Designation of routes and areas for motor vehicle use	n/a	All	Coconino	YES	YES	NO
Yeager Canyon Log Jam Removal	2020	Debris removal and re-location, tree trimming around the road culvert	< 5 acres	Unknown	Coconino	NO	YES	YES
Activities reported in FACTS for which NEPA decision field was unpopulated	Unknown	N/A	N/A	15,565/26,386/ 260 tree planting, 198 tree re-planting, 4,018 pesticide control of invasive species, 21,000 biocontrol of invasive species, 6,890 range cover manipulation, 11,345 weed and tree release	Tonto	YES	NO	NO

Project Name	NEPA Decision Year	Treatment Types	Acres <u>Planned</u> Mechanical/ Prescribed Fire/Other	Acres <u>Implemented</u> Mechanical/ Prescribed Fire /Other ⁵	Forest	Past	Current	Reasonably Foreseeable
Noxious Weed Treatment Projects	2005	Noxious weed treatment	-	61,015/1,008/ 2,021 pesticide control of invasive species, 11 biocontrol of invasive species	Tonto	NO	YES	YES
Cragin-Payson Water Pipeline and Treatment Plant	2012	Construct, operate, and maintain water transmission pipeline right-of-way	≤ 352/0/ ≤ 352 excavation, construction, and pipeline burial	0/0/0	Tonto	NO	NO	YES
North Zone / Highline Trail Improvements Project	FY 21	Trail reroutes and maintenance to also include decom and water crossings	50 plus miles of trail To be phased into multiple efforts	0/0/0	Tonto	Yes	Yes	Yes
Cable One	2019	Fiber optic cable installation	N/A	N/A	Tonto	NO	YES	NO
Dude Creek Restoration	2022	Headcut restoration	N/A	N/A	Tonto	NO	NO	YES
Haigler Creek Restoration	2023	Non-native fish removal, barrier placement	N/A	N/A	Tonto	NO	NO	YES
Travel Management	2021	Designation of routes and areas for motor vehicle use	N/A	All	Tonto	YES	YES	YES

Table 29. Wildfire history

Year	Acres
1943-1989	40,994
1990-1999	37,369
2000-2009	262,531
2010-2020	243,504
Total	586,306

**Figure 18. Wildfire history in the Rim Country project area**

Water and Riparian

The Water and Riparian Resource Specialist report (USDA FS 2022) is incorporated by reference. See the Water and Riparian Specialist report for detailed information.

Affected Environment

Water Quality

Water quality of surface waters has been assessed on 115.4 miles of streams within the Tonto National Forest portion of the Rim Country project area, primarily within the Salt River and Verde River watersheds. Approximately 73.3 miles of surface waters have been assessed within the Little Colorado Watershed mostly located on the Apache-Sitgreaves and Coconino National Forests. In addition, 5 lakes totaling 398 acres were assessed within the Rim Country footprint. The specific water quality status of specific streams, rivers, and lakes that have been assessed by the Arizona Department of Environmental Quality (ADEQ 2016) is available in the water and riparian resources report (USDA FS 2022).

Within the Salt River and Verde River Basins, primarily on the Tonto National Forest, water quality is attaining standards for some uses in 65.24 miles (57 percent), is inconclusive in 31.2 miles (27 percent) of streams and is not attaining/impaired in 18.2 miles (9 percent) of assessed streams. Within the Little

Colorado Basin, primarily on the Apache-Sitgreaves and Coconino National Forests, water quality is attaining standards for some uses in 62.3 miles (85 percent) and inconclusive on 10.9 miles (15 percent) of assessed streams. In addition, five lakes within the project area were assessed with one (125 acres) not attaining water quality standards for some uses, and three (totaling 273 acres) designated as impaired.

Some streams have had samples that exceed state water quality standards, however, most of the water bodies lack sufficient data to either remove or recommend impairment as there are state statutes dictating minimum data quality and quantity levels. The completion of a total maximum daily load assessment on impaired water bodies may result in developing additional water quality improvement strategies and mitigation of effects within associated watersheds.

The Upper Tonto Creek watershed includes stream reaches that are impaired for Nitrogen, Phosphorous, Low Dissolved Oxygen (D.O.), and E. coli. Total Maximum Daily Load (TMDL) assessments were completed for Nitrogen and E. coli bacteria in 2006. Sources of contamination were identified as inadequate septic systems and recreational sources. ADEQ has approved Water Quality Improvement Grants (grants that allocate funds from the US EPA for implementing nonpoint source pollution control projects) for improving septic systems at R-Bar-C Boy Scout Camp (2007), Tonto Baptist Camp (2008), and to Gila County (2006). The Forest Service has constructed new bathrooms, restricted vehicle access to maintain a buffer for the creek and converted portions of the area from overnight camping to day-use only. A TMDL for Phosphorous has not yet been scheduled and is identified as a low priority for development by ADEQ.

The Upper Tonto Creek watershed is identified as one of Arizona's Targeted Watersheds. These watersheds are a priority in the state for Clean Water Act (CWA) Section 319 Water Quality Improvement Grants and other strategies to restore and/or protect water quality conditions. Development of a TMDL for Low Dissolved Oxygen impairment in the Headwaters of Tonto Creek is identified as a low priority by ADEQ (ADEQ 2012, 2014).

Implementation of site-specific best management practices have been shown to be effective in mitigating impacts to water quality, and the development, implementation, and monitoring of best management practices are Forest Service responsibilities as described within the Memorandum of Understanding between the State of Arizona, Department of Environmental Quality and Forest Service Southwestern Region (USDA Forest Service 2019). The completion of a TMDL assessment on impaired water bodies may result in developing additional water quality improvement strategies and mitigation of effects within associated watersheds.

Stream Courses

Stream courses within the project area are generally low-gradient ephemeral and intermittent streams with dendritic drainage patterns, except in areas with very steep terrain such as mountains (extinct volcanoes) and cinder cones, which typically have radial drainage patterns with high-gradient ephemeral and intermittent drainages flowing in all directions from upper slopes. Approximately 4,047 miles occur within the analysis area, of which approximately 385 (10.5 percent) miles exhibit perennial flow.

Riparian and Stream Condition

In the Southwest, the Forest Service uses a system of ecosystem types, "ecological response units" (ERUs), to facilitate landscape analysis and strategic planning. ERUs have been built from plant associations and ecosystem units that have been identified through Terrestrial Ecological Unit Inventory (Wahlberg et al. 2014). Within the project area, there are approximately 21,330 acres identified as riparian by the Region 3 ecological response unit ecological response unit map (Triekpe 2014a and b). Table 30

shows the percentages of each ecological response unit within the project area. Of this total, the largest proportion consists of Narrowleaf Cottonwood/ Shrub with 35.6 percent, follow by Ponderosa Pine / Willow and Herbaceous (wetland) with 26.3 and 20.0 percent, respectively. Willow-Thinleaf Alder contributed 7.6 percent and each remaining unit comprised less than 5 percent of the total.

Table 30. Acres and percent of riparian ecological response units (ERUs)

ERU	Acres	Proportion
Arizona Alder - Willow	228	1.1%
Arizona Walnut	68	0.3%
Fremont Cottonwood - Conifer	169	0.8%
Fremont Cottonwood / Shrub	539	2.5%
Herbaceous (wetland)	4,270	20.0%
Historic Riparian - Residential/Urban	298	1.4%
Narrowleaf Cottonwood / Shrub	7,584	35.6%
Ponderosa Pine / Willow	5,607	26.3%
Sycamore - Fremont Cottonwood	946	4.4%
Willow - Thinleaf Alder	1,617	7.6%
Total	21,326	-

The three forests surveyed riparian condition using different assessment methods. Therefore, for necessity of this analysis all the forest data was cross walked into a single protocol for display and reporting. The protocol selected is the proper functioning condition (PFC) (Dickard et al. 2015). Reaches meeting PFC criteria are also in satisfactory riparian condition in terms of Land Management Plan standards. Channel morphology (drainage configuration) is typically too variable in ephemeral reaches to allow applying any sort of standard or expectation.

Riparian condition was either documented or estimated on a total of 876 miles of intermittent and perennial streams since the late 1990's. A compilation of condition information across the three forests within the project area is presented in the water and riparian specialist report (USDA FS 2022). A total of 257 miles (29 percent) were to be at PFC, with 475 miles (54 percent) at Functional at-Risk (FAR) and 145 miles (17 percent) rated nonfunctional.

The PFC summary data for the Tonto National Forest presented in the water and riparian specialist report estimated riparian conditions developed during the Watershed Condition classification analysis completed in March 2011. Twenty-four miles of riparian areas had been inventoried. The remaining stream channel condition classes were derived from gathering all existing riparian and stream information within each HUC12 watershed using the guidance found in the National Watershed Classification Technical Guide, Indicator #5 for Riparian/Wetland Vegetation Condition (Potyondy and Geier 2011).

Many of streams within the project area exhibit legacy effects from past land management, such as poor logging practices, poor road locations, overgrazing, among others. The effects of these practices include entrenchment of stream channels, increased gradient, decreased sinuosity, and subsequent decrease of floodplain accessibility. Superimposed on these conditions are the effects of recent (past 30 years) of uncharacteristic wildfires. Approximately 31 percent of the project area has experienced wildfire over the past 30 years. The Rodeo-Chediski wildfire burned through a large portion of the Rim Country project area. Other fires, such as the Dude Fire in 1990, still may exhibit residual effects from the change in cover density and type. Effects on the riparian systems from these fires include but were not limited to burning of the vegetation overstory, increased peak flows, increased bank erosion, and sediment transport

and deposition. PFC assessments conducted in 2004, two years after the Rodeo-Chediski wildfire, recorded substantial post-fire effects including downcutting, eroded banks, and direct loss (burning) of riparian vegetation.

Wetlands and Springs

There are approximately 1,000 natural lakes, reservoirs, and natural wetland depressions within the project boundary that impound water for a sufficient duration to exhibit some wetland characteristics and are therefore listed in the U.S. Fish and Wildlife Service National Wetlands Inventory database (USDI Fish and Wildlife Service 2021d).

Approximately 360 springs have been inventoried by the Spring Stewardship Institute within the Rim Country Project analysis area (Ledbetter et al. 2014). Of these 360 springs, 214 have survey information, 138 are unverified, and 8 were verified. Information regarding historic flow or water quality from these springs is minimal. Most springs within the project area are either rheocrene- meaning they flow directly from the ground resulting in a small stream, helocrene- they emerge from low gradient wetlands, or hillslope – they emerge from confined or unconfined aquifers on a hillslope (typically 30 to 60 degrees); often with indistinct or multiple sources.

Several springs within the project area are currently being assessed using the Spring Ecosystem Assessment Protocol (SEAP) (Stevens et al. 2016) with at least one objective being to document effects of thinning treatments, such as those proposed in this project, on spring discharge. Seventy-eight springs have been assessed using the SEAP protocol within the Rim Country project boundary. All these assessed springs are located on the Coconino National Forest. Eight percent of the springs were identified to be at moderate or greater risk. Many springs within the project area have been adversely affected by human activities including flow regulation through installation of spring boxes and piping of discharge to off-site locations, recreational impacts, urbanization, and other construction activities, and grazing by domestic livestock and wildlife herbivores.

Watersheds and Watershed Condition

The Rim Country Project lies within 141 sixth-level, or 12-digit, hydrologic units (sub-watersheds), 28 10-digit (watersheds) and 11 8-digit (sub-basins).

A watershed condition assessment was completed in 2011 for all sub-watersheds in the project area as part of an agency-level assessment of watershed conditions for each forest's watershed condition information is also included in the Soil and Watershed Specialist's Report (USDA FS 2022). Some of the sub-watersheds have very limited areal extent within the project and will not be analyzed further in detail.

The result of the analysis of all watersheds in the project area indicate 20 (15 percent) were rated as Functioning Properly, 111 (83 percent) were rated as Functioning at-risk, and 2 (2 percent) were rated as Impaired. This information is presented in appendix B of the Water and Riparian Resources Specialist report (USDA FS 2022).

Watersheds that are identified as Class 2 or 3 (Functioning-at-risk or Impaired rating) are a result of, in large part, overly dense forests with fire regime condition classes of 2 or 3 (moderately or highly departed from reference conditions), a high-density road network that can alter hydrology with many in close proximity to stream courses, a riparian condition rating (PFC) of Functioning-at-risk and Non-functioning condition, and lack of native fisheries or aquatic species in watersheds with perennial streams. Current conditions are dominated by overly dense forests that lead to high fuel loads with the potential of uncharacteristic wildfires. Uncharacteristic wildfires in many cases result in soils with high burn

severities that pose risk to watershed function, soil productivity, and water quality following storm events. High burn severity results in water-repellent soils, loss of protective vegetative ground cover and, following storm events, accelerated erosion and sediment delivery to connected stream courses that may degrade water quality. Consequently, accelerated erosion and sediment delivery into connected stream courses leads to loss of soil productivity and watershed function.

The distribution of ratings for these indicators related to water and riparian resources in the Rim Country project area are displayed in table 31. Overall, ratings indicate that water quality was the highest of the three indicators, with 70 percent of watershed at a good rating. This is followed by 48 percent of the water quality ratings as Good. Riparian/Wetland condition was the lowest with most ratings at 'Fair' condition and a greater percentage of 'Poor' ratings than 'Good.' This suggests that the Riparian /Wetland indicator is most departed from desired conditions and is critical to address for restoration.

Table 31. Distribution of ratings for water quality, water quantity, and riparian/wetland condition indicators within Rim Country

Indicator	Poor	Fair	Good
Riparian/Wetland Condition	27%	58%	15%
Water Quality Condition	6%	23%	70%
Water Quantity Condition	15%	37%	48%

Environmental Consequences

Water Quality

The indicators for water quality includes acres of vegetation (forest, woodland, grassland, riparian) restored by mechanical and prescribed burning, the number of miles of stream channel and number of springs proposed for restoration, the changes in road miles and unauthorized routes, and overall projected changes to water quality, most importantly potential changes with compliance with the Clean Water Act (1977).

Water quality in Arizona is reassessed and reported every 2 to 3 years by the State of Arizona. The latest assessment was documented in the Department of Environmental Quality in 2016 Clean Water Act Assessment (July 1, 2010 to June 30, 2015) (ADEQ 2016), which were updated by 2018 data that are yet to be published. The findings and recommendations of the water and riparian specialist report are summarized in the affected environment section.

Most adverse effects on these resources can be minimized or mitigated through appropriate use of resource protection measures such as Soil and Water Conservation Practices (SWCPs) and Best Management Practices (BMPs) as outlined in the Soil and Watershed Conservation Practices Handbook (USDA Forest Service Handbook 2509.22). Resource protection measures for the Rim Country Project are included as design features in appendix C. This project will incorporate BMPs, both general and site-specific, designed to protect water quality. A memorandum of understanding with Arizona Department of Environmental Quality and USDA Forest Service, Region 3 (USDA Forest Service/ADEQ 2019) states 'Ensure that all project work schedules for project implementation on the ground contain site-specific best management practices, developed through the LMP implementation process and consider technical, economical, and institutional feasibility and water quality impacts from the proposed activity in selection of the best management practices. Monitor best management practices on selective activities to ensure they are implemented and are effective, adjust as necessary.' An important best management practice feature is the aquatic management zone, which is an area adjacent to a waterbody where activity is

restricted or limited to project aquatic and riparian values at risk. The proposed aquatic management zone widths are outlined in the Rim Country Project design features (appendix C).

Water Quantity

Water quantity is discussed in terms of stable hydrologic regime, persistence of flow, peak flows, and discharge to waterbodies and springs. Surrogates to analyzing these indicators are similar to those for water quality and include acres of vegetation treated by mechanical treatments and prescribed burning, miles of roads opened and temporary constructed roads, decommissioned roads and unauthorized routes, and acres of rock pits and in-woods processing areas.

Riparian Resources

The indicators used to assess riparian include the miles of stream restoration, the number of springs proposed for restoration, and the number of acres proposed for vegetation treatments such as mechanical treatments and prescribed burning, including most importantly riparian and wetland areas. Other indicators include the miles of temporary roads constructed and Forest Service system roads reopened, the miles of Forest Service roads and unauthorized routes decommissioned. These are surrogates for assessing potential changes to resource conditions.

The Spring Stewardship Institute provided a spring inventory geodatabase for the project area, including Spring Ecosystem Assessment (SEAP) results for many springs (Ledbetter et al. 2014).

Cumulative Effects and the Watershed Condition Framework

As mentioned previously, although all Watershed Condition Framework indicators are interrelated to some degree, specific indicators such as water quality, water quantity, and riparian/wetland vegetation condition were used to evaluate watershed-scale cumulative effects for water and riparian resources. Other Watershed Condition Framework indicators are addressed in the soils and watershed specialist report (USDA FS 2022).

Alternative 1 – No Action

There would be no direct effects on water and riparian resources as a result of the no action alternative, however there would be indirect effects by not moving these resources toward desired conditions. Overstocked and dense stands within the project area would not be treated, leaving a less healthy, less resilient, under-productive forest. Risk of uncharacteristic wildfire would not be reduced. No improvement would be realized in woodlands, savanna, and grassland vegetation types where ground cover conditions are departed from desired conditions. No road decommissioning, rehabilitation of unauthorized routes or stream crossings would occur to improve water quality. Stream, wetland, riparian, and spring restoration would not be completed at the scale intended for this project. The project area would not move toward desired conditions, as outlined in the Apache-Sitgreaves (USDA Forest Service 2015), Coconino (USDA Forest Service 2018a), and Tonto (USDA Forest Service 1985) Land Management Plans.

Water Quality and Quantity

Absence of Mechanical Treatments and Prescribed Fire

It is likely that under any conditions, a wildfire entering these untreated watersheds under the no action alternative would have considerably greater impacts to water quality and channel stability than wildfire occurring after implementation of the action alternatives. Increased water turbidity, and downstream flooding would be more widespread in an uncontrolled wildfire situation than under prescribed fire

conditions where the size and intensity of the fire can be controlled. Increased sediment loads are the primary physical impacts to surface waters following fire. The bulking effect of sediment and ash in runoff increases the risk to surface water impoundments, infiltration basins, and public water treatment systems. Sediment and debris flows can damage water supply infrastructure. Sedimentation of impoundments can decrease their effective life, resulting in a need for dredging and other mitigation measures.

Soils with erosion rates that are exceeding tolerance thresholds would likely continue to erode at current rates. Sediment delivery to stream courses and waterbodies could continue at current rates or gradually increase from poor upland conditions. In areas where overstory densities are high, little long-term improvement in hydrologic flow regime will occur without mechanical treatment and/or prescribed fire. The soils in these areas have reduced moisture storage and infiltration capacity and are frequently overwhelmed by high intensity summer precipitation events, producing runoff events with relatively large peak flows of short duration. In areas that are overstocked with trees and encroached, water quantity would continue to decline as less water would be available for stream flows due to the closing of the overstory.

Absence of Riparian, Stream, and Upland Improvements

Riparian vegetation provides many water quality maintenance functions such as reducing surface water temperatures, which promotes high dissolved-oxygen concentrations, by blocking solar radiation. Stabilizing roots reduce the amount of bank cutting and erosion. Uptake by riparian vegetation can effectively remove excess nutrients and pollutants from water. Several stream reaches within the Rim Country Project area are experiencing increased peak flows and subsequent sediment delivery associated with high precipitation events from the poor upland conditions, which are the result of several fires which have occurred over the past 20 years, most notably the Rodeo-Chediski Fire of 2002. These increased flows are causing stream instabilities both vertically and laterally. Stabilizing riparian vegetation has been scoured away causing detachment and movement of channel and bank material impacting sediment concentrations downstream. Without active stabilization activities water quality will likely not improve as quickly as with the action alternatives.

Absence of Roads Activities

This alternative is not anticipated to produce any changes to existing water quality trends in the streams, springs and surface water bodies in or downstream of the project area. Open roads and unauthorized routes being used for motorized travel will continue to discharge runoff and sediment to project area streams, especially where the roads are poorly located in stream bottoms, have inadequate drainage structure, and are hydrologically connected to the stream network. The short- or long-term inputs of sediment into waterbodies caused by disturbance associated with the action alternatives would not occur.

Absence of Rock Pits and In-woods Processing Sites

The no action alternative would have slightly more potential of increased sediment yield to downstream perennial waters than the action alternatives because of the use and improvements of Forest Service system roads associated with the rock pits. Increased sediment yield by itself does not constitute an impact on water quality because the sediments leaving the road would have to enter a water body in large enough quantities to cause a change in beneficial uses. Maintaining roads to appropriate standards would be more difficult in this alternative due to the higher haul costs of bringing in rock from elsewhere. Fewer miles of roads surfaced combined with an increase in miles driven compared to the other alternatives would result in continued water quality impacts.

Riparian and Wetland Resources

Absence of Mechanical Treatments and Prescribed Fire

Excess erosion and sedimentation caused by flooding due to post-wildfire effects and poor upland watershed conditions can reduce riparian vegetation extent and vigor (Obedzinski 2001). Under the no action alternative and assuming the absence of wildfire, current trends in condition of riparian areas within the project area would be expected to continue. Riparian condition would not benefit from improving upland watershed conditions to desired conditions with mechanical and prescribed fire treatments. There would be no potential benefit from improvement of the hydrologic flow and altered sediment regime by restoring herbaceous ground cover. Fuel loading would remain high, thus there would be greater risk of high burn severity and subsequent flooding effects, which could negatively affect riparian condition. Tree density and canopy closure within the riparian areas would increase. Current levels of large woody debris would be available to the stream channel both from the riparian and adjacent upland zones. Areas where deciduous woody riparian vegetation is being shaded out by invading conifers would remain in that condition.

This alternative would result in riparian condition improvement at a slower rate than either of the action alternatives as there would be no direct reduction of conifer encroachment via mechanical and prescribed fire to increase the potential for expansion and vigor of riparian vegetation.

Absence of Riparian, Stream, and Upland Improvements

Many of the stream reaches accessed are not currently at desired conditions and are in less than proper functioning condition. Headcuts and other instabilities can adversely affect riparian vegetation by scouring away soils and stabilizing plants leading to channel entrenchment and subsequent lowering the water table. It is expected that riparian condition of these reaches would continue to decline or, if recovering, recover at a slower rate with the no action alternative than the action alternatives.

Absence of Roads Activities

Potential effects from construction of temporary roads and opening of closed Forest Service roads, such as increased runoff on disturbed soils and potential increased delivery of sediment to water bodies, would not occur with the no action alternative. Forest Service roads and unauthorized roads would not be decommissioned or relocated, therefore resource degradation from these roads would continue, and the improvement to riparian condition would not occur.

Absence of Rock Pits and In-woods Processing Sites

The absence of rock pits and in woods processing sites would have no impact on riparian or wetland resources because of the location of these away from these resources. The no action alternative would result in no additional acres of ground disturbance from rock pits and in little to no potential of sediment generation distribution from in-woods processing sites.

Effects Common to Both Action Alternatives

Water Quality and Quantity

Upland Mechanical Vegetation and Prescribed Burning Treatments

Water Quality

Fire, including prescribed burning, can disrupt nutrient cycling and cause nutrient volatilization, leaching, and transformations. When vegetation is consumed by fire some of the soil and organic matter nutrients

such as calcium, magnesium, and potassium are converted into oxides and accumulated in ash (DeBano et al. 1998). During precipitation events these compounds can be delivered to nearby waterbodies. Battle and Golladay (2003) found short-term concentration increases in pH, alkalinity, and dissolved organic carbon in burned wetlands compared to those unburned. The primary short-term risk to water quality from prescribed fire and mechanical vegetation treatments is from increased sediment input to water bodies from areas where ground cover has been reduced or eliminated. This risk is greatest where treatment activities result in soil disturbance or complete removal of vegetative ground cover in close proximity to drainages. Such areas would include designated stream crossings, skid trails, log landings, firelines, and areas with higher soil burn severity.

As reported in the soils and watershed specialist report (USDA FS 2022), erosion potential is expected to increase on 10 to 15 percent of areas treated mechanically due to removal or displacement of ground cover. However, this erosion would be short term (1 to 3 years) and localized. In the long-term, these treatments will likely increase vegetative ground cover and decrease the potential for high soil burn severity due to heavy fuel loading. As shown in erosion modeling results, sediment delivery from high to moderate soil burn severity areas is about twice that from low severity areas, the predominant severity class resulting from prescribed burning. Where uncharacteristic or high-severity wildfires have occurred, 36 percent of the terrestrial ecosystem survey strata exhibited erosion and sediment delivery rates above soil loss tolerance thresholds (USDA FS 2022). This is consistent with the modelling results presented in O'Donnell et al. (2018) that showed that total sediment yield was reduced in the mid-elevation ecoregions (ponderosa pine forest types) in northern Arizona where thinning treatments are being conducted as compared to baseline conditions. Thus, bringing these areas toward desired conditions will promote stability in hydrologic and sediment regimes.

Thinning of forest cover on soils currently characterized as unsatisfactory would improve those soils over the long-term by improving soil moisture and allowing greater sunlight penetration to the forest floor, resulting in an increase in forest understory consisting of desired herbaceous species. Vegetative recovery following fuel reduction treatments is generally rapid, with erosion rates typically returning to pre-treatment levels within 1 to 2 years (Elliot et al. 2000). The increased herbaceous vegetation would likely reduce soil erosion and associated sediment delivery rates by providing vegetative and litter ground cover. This increased ground cover effectively intercepts rain before it reaches soil surfaces, preventing detachment and entrainment of soil particles in runoff water, thereby promoting long-term improvement in water quality.

Management activities such as mechanical thinning operations, including cable operations, can if not implemented correctly result in soil compaction and disturbance resulting in reduced infiltration and increased soil erosion (Elliot 2010). Note that cable operations may result in less soil disturbance than traditional ground-based operations. Resource protection measures including best management practices (see design features) are included with this project to protect water quality are effective in preventing long-term degradation of water quality from sediment and point sources of contamination. The use of aquatic management zones in this project, to increase filtration capacity, have been shown to be capable of reducing sediment entering waterways to non-significant levels (Rashin 2006). These 'buffer zones' decrease the velocity of surface runoff that carry sediment and other pollutants from upland areas and trap them prior to entering waterways (Baker et al. 2004).

Water Quantity

Departures from historical ranges of variability (HRVs) in vegetation and fire regimes have the potential for alteration of hydrologic regimes. Excessive overland flows can increase channel flow volume and velocities, causing excess channel erosion and increased deposition downstream. The proposed

mechanical treatments and prescribed fire in the action alternatives would move portions of the uplands toward desired conditions. The increase in vegetative herbaceous cover would improve the ability of the watershed to intercept and retain water inputs (precipitation and snow melt). A return to a natural fire regime has been demonstrated to promote greater vegetation diversity and stability in water yields providing greater resiliency to drought and to disturbances such as fire (Boisrame et al. 2016 and O'Donnell et al. 2018). Herbaceous ground cover, residual plant material, and plant vigor would increase surface roughness, reducing runoff velocities and erosive energy. Soil compaction would break up and additional organic material incorporates into the soil horizons, allowing for reduced surface runoff, increased water infiltration, and moisture retention. Overall, these conditions would promote more stable hydrologic flow regimes.

Fuel reduction treatments in forested watersheds, including mechanical treatments and prescribed burning, can under certain circumstances result in long-term increases in water yields either on-site or downstream (Brewer 2008; Bosch and Hewlett 1982; Troendle et al. 2003, 2010), however, the quantity, timing and duration of these increases is uncertain. Treatment prescriptions that cover most of the watershed and remove greater than 20 percent of tree basal area would likely be needed to generate a detectable change in surface flows. Thinning treatments that allow more snow collection in openings, such as those prescribed in the action alternatives, could result in greater on-site water storage and yields, providing longer periods of flow in intermittent streams within and downstream of treatment areas (Zou et al. 2010). In drier ponderosa pine stands, increased annual yields of one-quarter to one inch would be realistic. A modeling effort presented in Robles et al. (2014) found that runoff in thinned ponderosa pine forests was about 20 percent greater than in unthinned forests, regardless if in a drought or wet period. However, these increases were temporary, occurring for less than six years following treatment, and were modest (0-3 percent) when compared to total mean runoff from the study watershed. Another hydrologic modelling effort presented in Moreno et al. (2016) concluded that any increases in mean and maximum streamflow will occur during El Nino events and the winter months. A study by Simonin et al. (2007) also found that positive effects on water outflow from thinning in ponderosa pine only occurred in wet winters. Bosch and Hewlett (1982) concluded, and subsequent data (Hornbeck et al. 1997), and modeling (Troendle et al. 2003, 2007) support that removing less than 20 percent of the basal area may result in a change in flow, but this change will not be detectable. In cases where there is a detectable hydrologic response to vegetative treatments, the observed response would be greatest in wet years and smallest or non-detectable in dry years. Regarding potential groundwater responses from forest restorative treatments, a groundwater-flow model (Wyatt et al. 2015) showed a 2.8 percent increase in groundwater recharge following simulated treatment over a period of 10 years for a similar ecotype. However, these gains were expected to decline rapidly after treatment completion due to vegetation regrowth and their associated increased evapotranspiration. Prescribed fires, when designed and used as a fuel reduction tool alone, are probably less likely to influence water yield than mechanical treatments or a combination of burning with mechanical treatments, because of the smaller reduction in basal area and lack of ground disturbance by heavy machinery.

Riparian, Wet Meadow, Spring, and Stream Restoration

Restoration activities described in the Aquatic and Watershed Condition-based Management approach could promote conditions for desirable water quality and quantity characteristics across the project area. A study by Hammersmark et al. (2008) demonstrated that restoration of a montane meadow system has the capacity to reestablish hydrological process such as increasing subsurface storage and groundwater levels and increase frequency and duration of floodplain inundation. Simple structures such as rock check dams in southwest streams have been shown to be effective in dampening of peak flows and increasing the slow

release of surface water (Norman et al. 2016). Reducing trees encroachment near riparian areas would allow for decreased precipitation interception, improved infiltration and water storage.

Riparian vegetation often acts as a mitigating influence on flooding. Riparian vegetation provides for instream roughness from the presence of live vegetation along stream banks as well as being a source of large woody debris. This roughness can reduce stream velocities effectively dissipating stream energy and increasing stream stage. The spreading of water out onto a floodplain promotes water entering into storage further dampening peak flow magnitudes and erosive stream power. Improving conditions in these areas would promote resiliency during uncharacteristic wildfires by reducing the potential for high-severity burning of riparian vegetation. Loss of riparian vegetation can decrease bank stability resulting in excessive erosion and sediment production.

Long-term water quality would benefit from promotion of soil and channel stability with improved dissipation of stream energy, water storage, and more stable flow regimes through maintenance or improved reestablishment of riparian vegetation conditions. Riparian vegetation also maintains cooler temperatures within water bodies by reducing the amount of solar radiation impinging on the water surface. Water quality improvements can also occur from nutrient uptake and storage by riparian vegetation. Installation of protective barriers placed around newly planted and existing riparian areas would improve plant vigor, density, and cover of riparian vegetation (Schulz et al. 1990).

Short-term effects to water quality and quantity from riparian, wetland, spring, and stream restoration activities would be minimized with implementation of design features (appendix C).

Roads Activities

Road related activities include road improvements, temporary road construction, decommissioning of system roads and unauthorized routes, and improvement and relocation of system roads. Approximately 5,127 miles of roads currently in the forest system road network would be needed for the activities proposed in the action alternatives. Of this total mileage, 1,682 would be included from the re-opening of maintenance level 1 (ML1) roads. Temporary roads would also be constructed. It is important to note that not all the ML-1 roads will be opened, or temporary roads constructed at the same time across the project area. Only those ML1 and temporary roads required for implementation in a certain area would be opened or constructed. These roads would be properly maintained during implementation and closed or decommissioned, following Forest Service policy and design features (see transportation specialist report (USDA FS 2022)), immediately after they are no longer required for thinning and restoration activities.

Vehicle traffic associated with project implementation, particularly trucks, can pulverize road surface aggregates, resulting in more fine particles that are easily transported in runoff. Additionally, the pressure of vehicular tires on saturated road surfaces can force fine particles from below the surface to move upward to the surface (Truebe and Evans 1994). Runoff from road surfaces can detach and transport the fine material from road prisms and ditches (Reid et al. 1984). In addition, road induce surface runoff can alter subsurface flow on hillslopes affecting the magnitude and timing of surface runoff. Road proximity and connectivity to drainages can strongly influence sediment delivery to watercourses and alter flow regimes in streams. Road and stream intersections are the primary locations where sediments are delivered to stream courses. Log hauling activities can create conditions conducive to higher sediment delivery rates (Reid et al. 1984). However, sediment production from roads diminishes over time after proper closure and non-use (Beschta 1978).

No long-term negative effect on water quality and quantity is expected from the action alternatives with regards to the proposed road activities. In the short term, it is possible that sediment inputs to area

watercourses would increase slightly from re-opened roads, constructed temporary roads, or improved roads in the project area. However, all opened roads and temporary roads would be closed and decommissioned, respectively, when they are no longer needed. Short-term effects on water quality would be minimized by employing design features for road decommissioning and rehabilitation, including BMPs which are effective in preventing sediment from reaching streams when strictly followed.

A total of approximately 800 miles of existing system roads and unauthorized roads would be decommissioned under both action alternatives. Road decommissioning activities could range from blocking the entrance, scattering boughs on the roadbed, revegetating and water barring, to removing fills and culverts, reestablishing drainage-ways, pulling back shoulders, and recontouring the slopes for full obliteration. These activities would return unproductive acreage to a more stable, productive status over the long term by improving water infiltration, naturalizing water flow, increasing vegetative ground cover, and reducing erosion. Upon completion of road obliteration activities, long-term erosion rates for decommissioned roads would be expected to approach natural erosion rates. Rehabilitation or removal of roads offers benefits including reduced sedimentation and decreased peak flows.

Rock Pits and In-woods Processing Sites

Rock Pits

The action alternatives include the use of 10 existing rock pits on the Coconino National Forest and use expansion of 11 existing rock pits on the Apache-Sitgreaves National Forests. Since each of the rock pits analyzed are required to be operated so that they have internal drainage, none of the proposed pits or expansion areas would result in sediment outside the boundary of the pit and there would be no direct effect on water bodies. The lower hauling costs associated with having more rock pits closer to activity areas, would result in more miles of roads with better surfacing. This would also limit effects on water quality from roads. Water quality would be expected to remain the same or improve because of the greater number of road miles surfaced and maintained.

The site selection criteria used for rock pits and expansions greatly reduce the potential for effects on waterbodies. Increased truck traffic would create some finer sediment on road surfaces and could increase sediment yield. The main concern with increased sediment yields would be from dust caused by the construction and use of the rock pits and facilities. However, increased sediment yield by itself does not constitute an effect on water quality because the sediments leaving the road would have to enter a water body and in large enough quantities to cause a change in the beneficial uses of that water body.

In-woods Processing Sites

Twelve processing and storage sites are proposed and analyzed for use, ranging in size from 4 to 21 acres. These sites were screened to be located outside of riparian areas and away from nearby streams where some of the most productive forest soils are found, as well as in relatively flat areas. The siting of processing sites in relatively flat areas would minimize the need for extensive site grading.

In order to facilitate the types of tasks and equipment that may be used at these sites, the sites would typically be required to be cleared and grubbed (vegetative cover and trees removed), resulting in displacement of topsoil and exposure of subsoil. The operation of equipment on these sites would result in compaction of the soil, reducing the ability of soils to infiltrate water. Areas of exposed soil would have to be covered with aggregate to minimize erosion and facilitate use of the site. The aggregate surfacing would cover the surface soil where it is not graded and would protect soil productivity. Various permits would need to be obtained for fuel storage, industrial site use, and stormwater pollution prevention. These permits would help to minimize effects on soil productivity and function.

Aboveground fuel storage tanks would have to be manufactured, installed, and operated in accordance with federal, state, and local requirements. For example, a permit for installation of an aboveground storage tank would have to be obtained through the Arizona State Fire Marshall's Office (<https://dffm.az.gov/fire-marshals-office>). Additionally, the processing sites would likely be regulated as industrial sites subject to permitting under the Arizona Department of Environmental Quality's Multi-Sector General Permit program (https://azdeq.gov/MSGP_Industrial/Non-Mining). This permit program requires that certain industrial facilities, including those involved in the types of activities that would likely occur at the processing sites, implement control measures and develop site-specific stormwater pollution prevention plans to comply with Arizona Pollutant Discharge Elimination System requirements (<https://azdeq.gov/permits/AZPDES/IND>). Among other things, the prevention plan would have to identify best management practices that minimize non-point source water pollution, including measures to minimize or prevent soil erosion and contamination.

Following completion of the use of processing sites and removal of all equipment and materials, site rehabilitation would be accomplished, including but not limited to removal of aggregate, restoration of pre-disturbance site grades, de-compaction of soil for seedbed preparation, tree planting, and seeding and mulching of the site with native grasses and forbs.

The selection for processing sites included the following criteria: flat uplands less than 5 percent slope; more than 200 feet from ephemeral and intermittent stream channels, and more than 300 feet from meadows, springs, and karst features. These selection criteria considerations, in addition to the Rim Country design features (appendix C) specific to these sites would minimize effects to water and riparian resources.

Riparian Resources

Upland Mechanical Vegetation and Prescribed Fire Treatments

Upland mechanical thinning and prescribed burning treatments, including cable operations, should reduce the risks to riparian vegetation communities and ecosystem integrity from scorching, and damaging peak flows associated with uncharacteristic wildfire. The effects of wildfire and prescribed burning activities on riparian areas are highly dependent on position of fire within the watershed, proximity to riparian areas, and position relative to mainstream channel and tributaries (Dwire et al. 2016). In general, the hotter a watershed burns, the greater the extent of burning within riparian areas.

Reductions in upland tree density and the long-term maintenance of forest openings should respond with greater overall water yield, increased stream flow (Brewer 2008) longer periods of intermittent stream flow, and higher hydrological connectivity. In addition, the reduction of canopy cover near riparian areas would stimulate the development of understory vegetation including deciduous woody riparian vegetation (such as, aspens, willows and cottonwoods). Increased infiltration resulting from the vegetative treatments such as prescribed burning promotes infiltration of excess moisture into sub-surface storage increasing groundwater levels as demonstrated in Tucker (2007) and simulated in groundwater models (Wyatt et al. 2015), resulting in a slower release of water. Increased water availability would support riparian vegetation diversity, abundance, and vigor, thereby supporting channel bank stability. The long-term effects of these treatments would likely improve riparian, stream channel, wetland, and spring conditions and functionality more quickly than the no action alternative. Adherence to project design features would limit the extent and degree of effects from mechanical thinning and burning activities both in the uplands and riparian areas. Treatments in AMZs would be limited in scope, space, and time to achieve multiple resource management objectives.

Riparian, Wet Meadow, Spring and Stream Restoration

Thinning activities and prescribed burning activities targeted for riparian resources including in around streams, wetlands, and springs will have effects similar to those described in the prior section on effects to riparian resources from upland mechanical vegetative and prescribed fire treatments. Leaving riparian areas untreated and with higher fuel loading, while treating fuel loading in the uplands can produce high fire severities in these areas (Dwire et al. 2016). These higher severities can reduce riparian vegetation abundance and diversity and take several decades to recovery to pre-fire conditions.

Treatments can also produce other desirable effects such as potentially more groundwater and surface water to be available to promote riparian vegetation abundance and vigor. As stated previously adherence to project design features would limit the extent and degree of effects from mechanical thinning and burning activities both in the uplands and riparian areas. Treatments in AMZs would be limited in scope, space, and time to achieve multiple resource management objectives.

Activities included in the Aquatics and Watershed Condition-based Management approach would directly improve riparian and hydrologic conditions and functionality within and adjacent to stream channels with implementation of stabilization techniques and treatments that modify stream sinuosity, width/depth ratio, and gradient. Grade control structures are useful for reducing degradative stream energy and aggrading entrenched systems thereby reconnecting stream channels to their floodplains. Norman et al. (2016) reported that check dam treatments resulted in lower runoff responses, including peakflows, to precipitation events as compared with untreated watersheds. Vertical instabilities such as headcuts can adversely affect riparian vegetation by the scouring away of plants and soil substrate, from the disconnection of the riparian vegetation root zone from the water table. Reduction of bank erosion would increase stream channel function and the moisture-holding capacity of hydric soils, improving conditions for riparian vegetation production. Degraded wet meadows could be restored by transplanting native herbaceous species and reposing steep banks.

Upland soil stabilization would be completed at sites where soil conditions are contributing to gully formation. Stabilization techniques would include hand or heavy mechanical methods, depending on site needs, access, and other resource concerns. Native vegetation would be expected to reestablish in these areas soon after restoration activities are completed (approximately one to three years). In some areas, riparian vegetation production would be augmented with planting of riparian herbaceous and woody species appropriate to those locations reducing the susceptibility of these sites to invasion by noxious and invasive weeds. Protective barriers, such as exclosures, around riparian areas would reduce the browsing and trampling effects from large ungulates, since continued heavy to extreme use of woody species could limit plants' ability to regenerate (Winward 2000). The use of exclosures has been shown to greatly increase both herbaceous and woody canopy cover, biomass, and litter cover in riparian areas (Schulz and Leininger 1990). Design features in appendix C would minimize potential water quality effects.

Roads Activities

Riparian areas, wetlands, stream channels, and springs would not be directly affected by temporary road construction as it is prohibited in or near these resources in the project design features. Additionally, indirect effects are expected to be minimal. Poorly located roads and unauthorized routes can degrade soil conditions and cause channel instabilities resulting in excess erosion and deposition, which may affect riparian diversity, extent, and vigor. Decommissioning of Forest Service system roads and user-created roads could improve functionality of riparian areas, stream channels, wetlands, and springs.

Rock Pits and In-woods Processing Sites

The selection criteria of processing sites included the following: flat uplands less than 5 percent slope, more than 200 feet from ephemeral and intermittent stream channels, and more than 300 feet from meadows and springs. These considerations, in addition to other relevant design features, should greatly reduce the potential for effects on adjacent riparian resources from the use of rock pits and in-woods processing sites.

Effects Unique to Each Action Alternative and Differences among Them

Water Quality and Quantity

General Mechanical and Prescribed Fire Treatments

Proposed mechanical vegetative and prescribed burning treatments acres differ between the action alternatives, 875,320 and 468,160 for alternatives 2 and 3, respectively. This amounts to a 46.5 percent difference between alternatives. There is an even greater difference, 29.4 percent more, in proposed treatment acres in the savannah vegetation type for alternative 2 as compared to alternative 3. Prescribed fire only acres were also lower in alternative 3, with 60,100 acres proposed as compared to 114,559 acres in alternative 2, which is a 47.5 percent difference.

Short-term water quality effects would be less for alternative 3 as compared to alternative 2 because of the decreased potential for sediment reaching waterbodies from ground-disturbing activities associated with mechanical vegetation and prescribed burning treatments. However, in the long term, alternative 3 would likely result in decreased long-term water quality benefits from fewer upland treatment acres that are currently not meeting desired conditions being treated. Thus, alternative 3 would have less of a benefit to downstream aquatic and riparian area habitat. Overall, both alternatives would maintain compliance with the Clean Water Act through strict adherence to design features.

Regarding water quantity, alternative 2 with more treated acres, could promote increased water yield over a period of time including increased discharge downstream and more stable hydrological flow regimes. Springs would likely receive more groundwater recharge, promoting increased outflows.

Road Activities

More miles of temporary roads would be needed for alternative 2 because more acres are proposed for mechanical and prescribed fire treatments. Up to 330 or 170 miles are proposed for implementation of alternatives 2 and 3, respectively; a 49 percent difference. In the short-term, a greater number of temporary roads over the project area would remove more vegetation, exposing and compacting more bare soil, potentially leading to increased concentrated flows and sediment delivery to waterbodies. It should be noted that a potential increase in the magnitude or duration of effects from a greater number of temporary roads will likely be spread over a larger geographical area, including many additional watersheds. All temporary roads would be decommissioned once the intended use ends and treated to eliminate motor vehicle traffic and permit the reestablishment of vegetation to minimize erosion with intent to return to a natural state. Activities for decommissioning range from blocking the entrance, scattering boughs on the roadbed, revegetating and water barring, to removing fills and culverts, reestablishing drainage-ways, pulling back shoulders, and recontouring the slopes for full obliteration. Overall, the short-term effects of temporary road activities in either action alternative would be minimized with the use of specific road erosion control design features (appendix C).

Riparian and Wetland Resources

General Mechanical Treatments and Prescribed Fire Including Treatments in Savannas

The general effects of mechanical treatments and prescribed fire, including treatments in savannas, on riparian and wetland resources are described in the Effects Common to Both Action Alternatives section, and apply to this section. Acres of mechanical and fire treatment differences between Alternatives 2 and 3 amounted to a 46.5 percent difference. The difference in mechanical treatment and burning treatment acres proposed in grassland and savanna vegetation types between alternative 2 and 3 was 29.4. Prescribed fire only acres between the action alternatives resulted in a 47.6 percent difference.

As these proposed treatments are primarily upland treatments, direct effects on riparian and wetland resources are not expected. With regards to indirect effects, the additional treatment acres proposed in alternative 2 (48 percent more mechanical and prescribed fire, 26 percent more prescribed fire only) as compared with alternative 3, would bring more acres toward desired conditions. Therefore, alternative 2, will to a greater extent reduce the potential for riparian impairment caused by impaired upland watershed conditions. Alternative 2 would also to a greater proportional extent promote longer periods of intermittent stream flow and groundwater recharge available to spring systems by bringing upland tree densities and forest openings to desired conditions. This would in turn support riparian vegetation vigor and wetland functionality.

Road Activities

More miles of temporary roads are required for alternative 2 because more acres are proposed for mechanical and prescribed fire treatments. Up to 330 are proposed for implementation of alternative 2, a 49 percent increase, as compared to alternative 3 with proposed 170 miles. With fewer miles of temporary roads proposed, there is likely less potential for negative effects to riparian and wetland resources than with alternative 3. Poorly located and high road densities can concentrate surface flow potentially causing increased peak flows damaging to these resources. The potential effects of temporary roads on riparian, spring, and wetland resources will be minimized with strict adherence to project design features (appendix C). Specific design features which include the use of aquatic management zones, would be employed to protect these sensitive areas in both action alternatives. No temporary roads are to be located in close proximity (as defined as the aquatic management zone width) to these resources. It should be noted that a potential increase in the magnitude or duration of effects from a greater number of temporary roads outside AMZs would likely be spread over a larger geographical area, including many subwatersheds, thus in essence spreading out potential effects to riparian and wetland resources. All temporary roads would be decommissioned once the intended use ends and treated to eliminate motor vehicle traffic and permit the reestablishment of vegetation to minimize erosion with intent to return to a natural state. Activities for decommissioning range from blocking the entrance, scattering boughs on the roadbed, revegetating and water barring, to removing fills and culverts, reestablishing drainage-ways, pulling back shoulders, and recontouring the slopes for full obliteration.

The number of miles of Forest Service managed roads would return to pre-implementation numbers or those determined through the Travel Management Rule (TMR) process for each forest. Thus, changes in open road density would be temporary, most likely two years or less.

Cumulative Effects Analysis

Spatial and Temporal Boundaries and Relevant Activities

The spatial boundaries appropriate for cumulative effects analysis of water quality, water quantity, and riparian resources are watershed boundaries. Water and riparian resources are primarily located in bottom

lands which are strongly influenced by runoff from the surrounding topography. Multiple land-use changes and activities in the uplands and upstream areas can have an additive (cumulative) effect to these resources. Using the subwatershed (HUC12) hydrologic unit is consistent with the Forest Service Watershed Condition Framework (WCF) (USDA Forest Service 2011b), which has attributes specific to these indicators.

Cumulative effects to water quality, water quantity and riparian resources include effects associated with past, present (ongoing) activities and those that are reasonably foreseeable. Aerially speaking, by far most the largest types of past, present, and reasonably foreseeable activities, excluding grazing, involve mechanical vegetative and prescribed burning treatments. Other activities include reforestation, spring and meadow restoration, and noxious or invasive weed and vegetative management along transmission lines. Reasonably foreseeable activities include projects with completed NEPA (planned) that are to be implemented and those anticipated occur in the future. Some of the more relevant projects include mechanical thinning in the Cragin Watershed Protection Project (<https://www.fs.usda.gov/project/?project=46075>), the Rodeo Chediski Mastication projects, and several large prescribed burning projects such as the Haigler Fuels Analysis. Several woodland, grassland, and spring restoration projects are also proposed in the Heber Allotment Analysis (<https://www.fs.usda.gov/project/?project=43442>) and the Mogollon Rim Spring Restoration Project. Other projects in the planning stage include the Apache-Sitgreaves National Forests Travel Management Rule (TMR) with an expected decision in 2021 (<https://www.fs.usda.gov/project/?project=22692>). The Tonto National Forest issued the final record of decision in 2021 (<https://www.fs.usda.gov/project/?project=28967>). Superimposed on these activities are the effects associated with this project alternatives.

Water Quality and Quantity

Alternative 1 – No Action

Cumulatively, when considering the past, present, and reasonably foreseeable future activities, the no action alternative would have fewer short-term effects on water quality associated with the action alternatives. This is primarily because ground disturbing activities associated with mechanical vegetative treatments, prescribed burning, riparian and wetland restoration, and transportation activities associated would not occur.

Cumulative effects from current livestock grazing would continue under alternative 1 and includes minor, generally localized soil compaction, puddling, displacement, and erosion from livestock trailing and in areas where animals congregate. Livestock trails make up a very small portion of the total project area. There are no anticipated changes to the 303d listed impaired waters from the magnitude cumulative effects under alternative 1. However, the long-term positive effects of bringing areas toward desired conditions through implementation of the proposed action would not occur.

Alternative 2 - The Modified Proposed Action and Alternative 3 – Focused Restoration

Long-term, beneficial watershed cumulative effects would likely occur with alternative 2 more so than 3. On average, the proportional extent of vegetative treatment (which comprise by far the largest of all project activities) within a subwatershed (that portion managed by the Forest Service) will be increased by approximately 30 and 19 percent, respectively, from implementation of alternative 2 and 3, as compared to the no action alternative. Coupled with the on-going and reasonably foreseeable projects, the overall proportion of a subwatershed covered, through NEPA, by potential vegetative treatment will increase to an average of 61 percent and 50 percent, respectively. Using the no action alternative as a baseline, 67 percent of Rim Country subwatersheds could receive a proportional increase of up to 25 percent additional coverage of vegetative treatment from alternative 2 as compared to alternative 3.

Fifteen percent additional watersheds would receive 75 percent or greater vegetation treatment coverage (proportionally) from alternative 2 as compared to alternative 3.

Augmenting the movement of upland and bottom lands (riparian and wetland areas) vegetative cover and composition toward desired conditions would reduce the risk of undesirable loss of overstory and ground cover, while stimulating vigorous plant growth, promoting infiltration rates, reduced overland flow, thus promoting overall stable hydrologic and sediment regimes. Riparian and wetland restoration activities and transportation footprint reduction activities will further complement the upland treatments from other projects in the cumulative effects boundary in promoting the improvement of water quality and water quantity indicators.

The short-term past, present, and reasonably foreseeable activities coupled with the action alternative would have similar incremental, short-term effects from ground disturbing activities to riparian and wetland resources. In the long-term, the combination of restoration activities in the project action alternatives including but not limited to stream and wetland stabilization, riparian planting and protection barriers, road decommissioning, and upland vegetative treatments, and other similar activities in the cumulative effects boundary would bring these systems closer to desired conditions, thus promoting the improvement of the riparian indicator based on the Watershed Condition Framework.

Summary

The WCF water quality, water quantity, and riparian indicator scores are expected to be maintained or improved with the of past, present, and reasonably foreseeable actions combined with the activities proposed in the action alternatives. Although future watershed restoration activities are expected to have long-term benefits to watershed condition, the intensity of coincidental watershed activities (too large a proportion of a given HUC12 subwatershed over too short a time) could potentially lead to negative effects, including unstable hydrologic and sediment delivery regimes, and subsequent impacts to riparian vegetation. Specific design features (appendix C) for water and riparian resources been included in this project to minimize these cumulative watershed effects.

Soils and Watershed

Affected Environment

This section provides information about the existing conditions of the affected environment for soils and watershed resources within the project area of about 1,240,000 (with potential restoration treatment area of 991,030 acres). It also includes an analysis of watershed conditions at the 6th Hydrologic Unit Code (HUC) level. This section establishes the baseline against which the decision maker and the public can compare the effects of all action alternatives.

This section incorporates by reference pages 54-77 of the soils and watershed specialist report that includes the Affected Environment. Also incorporated by reference is appendix A of the soils and watershed specialist report displays the terrestrial ecosystem survey map unit stratification and soil interpretations based on similar soils properties and behavioral characteristics, vegetation communities and management risks, limitations and potentials. Appendix B of the soils and watershed specialist report displays the existing and desired conditions, need for change and potential management strategies in tabular format by terrestrial ecosystem survey map unit stratum.

Affected environment of riparian resources, water quality, and water quantity is analyzed in the water and riparian resources specialist report (USDA FS 2022).

There were 186 terrestrial ecosystem survey map units from the 3 forests that were aggregated into 30 landscape unit strata. Each stratum has similar soils properties, slopes, climate regimes and vegetation communities. These soils also have similar limitations, hazards, suitability for various management activities and production potentials. The strata were used in part to design treatments, analyze effects and are based on the potential plant community and capabilities of the soils.

Assumptions and Methodology

This section describes the methodology and analysis processes used to determine the environmental consequences to soils and watershed resources from implementing the alternatives. Environmental consequences will be described with qualitative and quantitative descriptions supported by past studies and relevant literature.

Analyses for environmental consequences to soils and watershed resources that may result from implementation of each alternative were conducted using information contained in the Terrestrial Ecosystem Survey of the Apache-Sitgreaves, Coconino, and Tonto National Forests, the Watershed Condition Framework, Ecological Response Unit inventory maps (Triepke et al. 2014a and b), Forest Land Management Plans, Arizona Department of Environmental Quality (ADEQ), information obtained from other resource specialists, other agency reports, available literature, and input from collaborators, cooperators, and stakeholders. Geospatial analysis was used to quantitatively and qualitatively assess soils and watershed conditions using Geographic Information Systems (GIS) data obtained from a variety of sources.

Soil and Water Resources Condition Indicators

For soil resources, the units of measure of effects to soil resources will be the acres and severity of ground disturbance from equipment use and acres subjected to high soil burn severity. Most adverse effects to soils and water resources can be minimized or mitigated through appropriate use of resource protection measures and design features such as soil and water conservation practices (SWCPs) and best management practices (BMP's) as outlined in Soil and Watershed Conservation Practices Handbook (Forest Service Handbook 2509.22) (USDA Forest Service 1990), the National Core Best Management Practices Technical Guide (FS990a) (USDA Forest Service 2012a), and other relevant best management practices guidance.

For water quality measures, no physical stream measurements will be taken to determine water quality. A narrative description will explain the effects to water quality by alternatives.

Soils

Soils throughout the project area were mapped as part of the terrestrial ecosystem survey of each forest. This information is available at the respective Forest Supervisor's Offices.

The terrestrial ecosystem survey follows National Cooperative Soil Survey Standards similar to Soil Surveys conducted by the Natural Resource Conservation Service (NRCS). The terrestrial ecosystem survey is the result of the systematic analysis, mapping, classification and interpretation of terrestrial ecosystems, also known as terrestrial ecological units, that are delineated and numbered. A terrestrial ecosystem survey represents the combined influences of climate, soil and vegetation, and correlates these factors with soil temperature and moisture along an environmental gradient. It is an integrated survey and hierarchical with respect to classification levels and mapping intensities.

Interpretations based upon terrestrial ecosystem survey incorporate (1) soil physical and chemical properties, (2) climatic considerations, (3) topographic position and slope, (4) vegetation and

anthropogenic influences as well as animal effects, (5) productive and successional potentials, and (6) geologic influences. As such the terrestrial ecosystem survey can form the ecological basis for describing existing conditions for resource areas including watershed, wildlife, fire, and timber.

Erosion Modeling

Erosion modeling was completed using the Forest Service Water Erosion Prediction Project (FSWEPP) program ((Elliot et al. 2000) at <https://forest.moscowfs.wsu.edu/fswepp/>) and with site specific data (climate, slope, soil surface texture, length to drainage, cover percentage, and rock content) to determine upland erosion and sedimentation into stream channels. Upland erosion and sedimentation into stream channels rates are estimated up to three years for prescribed burning and five years for wildfire scenarios. The WEPP model has been validated for use in the Southwest (Arizona and New Mexico) through research on hydrologic processes to predict responses of soils to disturbances (Bolton et al. 1991, Paige et al. 2003).

Watershed Condition Class and Prioritization Information

It is important to note that the condition class of a watershed represents the effects of all activities within a watershed, including those of other landowners. The Watershed Condition Framework (WCF) therefore provides an ideal mechanism to describe the cumulative effects of a multitude of management actions on soil and hydrologic function (USDA Forest Service 2011b). WCF is a rating system that classifies the physical and biological characteristics within a watershed that may impact the hydrological and soil functions supporting aquatic ecosystems (USDA Forest Service 2011b).

It is reasonable to expect that treatments resulting from implementation of the proposed action or other action alternatives would result in some short-term, localized negative effects due to soil disturbance caused by use of heavy machinery for mechanical forest restoration treatments (including commercial timber harvests), burning of piled woody debris, and broadcast prescribed fire (Debano 1998, Hungerford et al. 1991). These disturbances would also occur on soils where previously completed projects overlap proposed or future activities in watersheds across the project area, resulting in a cumulative effect to soils and watersheds. However, no long-term, cumulative adverse effects from ground disturbance caused by mechanical thinning or prescribed fire (compaction, topsoil displacement, extensive areas of high soil burn severity, etc.) are anticipated to occur at a severity or spatial extent to negatively affect overall soils and watershed conditions. In general, proposed restoration treatments are expected to result in improvement in overall soils and watershed condition in proportion to the areal extent of the restoration treatments within each watershed.

Environmental Consequences

This section describes the direct, indirect, and cumulative effects of implementing each alternative on the soil and water resources in the Rim Country Restoration Project analysis area. It presents the scientific and analytical basis for the comparison of the alternatives presented in Alternatives section and establishes the baseline against which the decision maker and the public can evaluate the effects of the action alternatives.

Alternative 1 – No Action

The alternative 1 would result in no changes to current rates of vegetation management, commercial timber harvesting, pre-commercial vegetation treatments, or other mechanical or non-mechanical fuels reduction treatments; no changes to road construction, maintenance, or decommissioning; and no changes to prescribed fire implementation or wildfires managed for resource benefits within the Rim Country Restoration project area. These activities would continue at the current scale and rate. Planned projects

(Cragin Watershed Protection Project, etc.) would be implemented in accordance with official decisions and available funding. Therefore, there would be no changes to current direct effects to soils, water quality, ephemeral or intermittent stream channels, or watershed condition as a result of the no action alternative. Other proposed activities such as restoration of springs, riparian habitats, grasslands, and meadows would continue at current rates rather than the accelerated rate proposed in the action alternatives. These important landscape features and wildlife habitats would be expected to remain in degraded or impaired conditions for longer periods than under the action alternatives.

Due to the substantially extended temporal timeframe and reduced scale under which restoration actions would occur under the no action alternative (individual projects rather than landscape-scale restoration), it is reasonable to expect that short term adverse effects to soils and watershed conditions that result from mechanical and prescribed fire treatments would also occur at a reduced rate and scale.

Absence of Upland Vegetation Treatments and Prescribed Fire

Since tree basal area or density reduction of currently overstocked stands within the project area would not occur at the same rate as under the action alternatives, increased fuel loading in both living biomass and woody detritus would be expected through natural forest ingrowth and tree encroachment into existing openings followed by forest decadence caused by intraspecific and interspecific competition. Additionally, forest ingrowth would continue to increase “ladder fuels” which allow ground fires to ascend and spread quickly as crown fires. Coarse woody debris would be expected to increase over time as small, medium, and large diameter material begins to fall to soil surfaces and decay. While these conditions may improve soil quality in some regards (organic matter accumulation in subsurface horizons, microhabitat for soil organisms and increased organism populations, increased water holding capacity) they would also result in an increased risk of high-severity wildfires where fuel loading becomes excessive.

The location, size and severity of future wildfires cannot be estimated with accuracy, although some generalizations can be made. High severity wildfires tend to occur in areas where fuel loading and fuel distributions are sufficient to carry a fire. Typically, uncontrolled wildfires occur during the drier times of the year, yielding higher severity fires than would occur under prescribed fire conditions. The adverse effects of a high-severity wildfire, such as the loss of forest floor organic matter, increased soil erosion and sediment delivery to waterbodies, and changes in soil habitat and biota would be more widespread in an uncontrolled wildfire than under prescribed fire conditions (DeLong et al. 2017, Spigel and Robichaud 2005). The primary effect of high-severity wildfire on soil productivity is the removal of understory vegetative cover and surface organic matter (loss of protective cover and nutrient stores), exposure of soil surfaces to erosion by wind and water, and exposure of soils to solar radiation, which increases soil temperatures and reduces soil moisture. If surface organic matter is reduced (as happens under high-severity, long-duration fire) the cation exchange capacity of the soil is also reduced and the ability of the soils to retain nutrients leached from ash also decreases.

In the absence of mechanical vegetation and fuels treatments and prescribed fire, a high-severity wildfire would very likely result in increased surface runoff and downstream flooding, soil erosion, and sediment delivery to stream courses as a result of loss of effective ground cover at the soil surface, reduced rainfall interception, and reduced soil water infiltration rates. The infrequent nature of ephemeral stream flow results in the potential for sediment and ash to be stored within these stream channels and then transported during the larger surface runoff events. This, in turn, could pose detrimental effects to surface water quality and water storage capacity in livestock and wildlife waters.

This alternative would result in no additional acres of ground disturbance over current levels from tree felling, piling of activity-related woody debris, use of prescribed fire, temporary road construction, or expansion of gravel pits. Risk of uncharacteristic wildfire would not be reduced at the same rate as the action alternatives. No improvement would be realized in forested areas, woodlands, savannas, and grassland vegetative types where vegetative ground cover conditions are departed from desired conditions. No road decommissioning, or rehabilitation of unauthorized routes or stream crossings would occur above current levels. The project area would therefore not move toward desired conditions as outlined in the Apache-Sitgreaves, Coconino, and Tonto **National Forest Land Management Plans** as rapidly as under alternatives 2 and 3.

The no action alternative would not adequately contribute to reduced forest vegetation densities, desired fire regimes, and forested conditions that would provide resilience against uncharacteristic disturbances such as high-severity wildfire, insect and disease outbreaks, and prolonged drought or climate change induced mortality. Currently 36 percent of the Rim Country project area has a fire hazard index of moderate or higher, which presents difficult and dangerous suppression conditions during a wildfire and potential for adverse post fire effects on soils and surface water quality. Four percent of the landscape is in the very high category (Fire Ecology and Air Quality Specialist reports). Under dense forested condition, litterfall has resulted in thick forest floor litter layers that have displaced native plant communities. These native plant communities provided greater benefits to watershed condition and soil hydrologic function than litter alone through improved fine root turnover rates, increased fine litter, improved soil porosity and aggregate stability, increased water holding capacity, and increased organic carbon sequestration.

High severity wildfires can cause damaging flows to streams resulting in high levels of sediment and ash inputs as well as increased risk to riparian areas and other downstream values at risk, including forest infrastructure. It is likely that under any conditions, a wildfire entering these untreated watersheds under the no action alternative would have considerably greater effects to soil productivity, water quality and channel stability than wildfire occurring after implementation of the action alternatives. Increased water turbidity, and downstream flooding would be more widespread in an uncontrolled wildfire situation than under prescribed fire conditions where the size and intensity of the fire can be controlled. The bulking effect of sediment, ash, and debris in runoff increases the risk to surface water impoundments, infiltration basins, and public water treatment systems. Sediment and debris flows can damage water supply infrastructure (Blandon et al. 2014). Sedimentation of impoundments can decrease their effective life, resulting in a need for dredging and other mitigation measures.

In areas of high stand densities, long-term improvement in hydrologic processes will not occur in the absence of mechanical treatment and/or prescribed fire. The soils in these areas have reduced moisture storage and infiltration capacity and are quickly saturated by high intensity summer monsoon precipitation events, producing runoff with relatively high peak flows of short duration.

Other potential detrimental effects to hydrologic conditions in the project area and downstream locations could include the destabilization of the geomorphic conditions of stream channels due to excessive sediment delivery and debris loading, increased peak flows, and overall increases in average annual water yield resulting from loss of upslope interception, infiltration, and evapotranspiration. Ephemeral stream channels within high burn severity areas would lose their ability to buffer runoff from large rainfall events, resulting in increased channel scour and incision caused by accelerated runoff and erosion from severely burned watershed areas. Increased bedloads in stream channels effectively raises the elevation of stream bottoms, causing flood flows to exceed channel capacities, resulting in overland flooding.

In the absence of vegetation treatments proposed in alternative 2, including prescribed fire, approximately 991,060 acres of soils resources and watersheds would not be improved.

In the absence of vegetation treatments proposed in alternative 3, including prescribed fire, approximately 528,850 acres of soils resources watersheds would not be improved.

Absence of Riparian Area, Wet Meadow and Stream Restoration Treatments

Watershed condition is dependent on the condition of the riparian communities that exist within the watershed. The benefits of riparian areas in the project area cannot be over emphasized. Riparian areas help capture pollutants including sediment and nutrients, contribute to channel stability by providing protective vegetative cover and root biomass that anchors soils, regulate water temperatures by providing shade, provide areas for floodwater storage and dissipation and are important wildlife habitat features. The increased flows have resulted in vertical and lateral channel instability in many intermittent and perennial stream reaches. Riparian vegetation has either been scoured away or reduced through increased channel incision that has detached riparian communities from adjacent floodplains. Stream channel substrates have been altered through increased runoff and in-channel transport. In the absence of proposed riparian, wet meadow, and stream restoration activities, watershed condition would not be improved on 21,280 acres of riparian areas, wet meadows and stream channels. As a result, these areas will continue to not meet desired conditions as outlined in Land Management Plans and existing risks to water quality would persist.

Absence of Road Decommissioning

Roads are a major contributor to surface water quality degradation and long-term loss of soil productivity. Additionally, system (permanent) roads convert productive soils to a non-productive condition for the long term (typically greater than 50 years). They therefore constitute an irretrievable, but not irreversible commitment of resources. Irretrievable is a term that applies to the loss of production, harvest or use of natural resources. Irreversible is a term that describes the loss of future options. It applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or those factors, such as soil productivity, that are renewable only over long periods of time. Since soil productivity can be restored through application of remedial measures such as disking, ripping, revegetating, etc., loss of soil productivity is not irreversible. However, soil productivity is lost throughout the duration that a road exists on the landscape.

Under the no action alternative, decommissioning of up to 200 miles of existing system roads on the Coconino and Apache-Sitgreaves National Forests, and up to 290 miles on the Tonto National Forest and 800 mile of unauthorized road would not occur. Based on an average width of 12 feet, there are approximately 1,877 acres of roads planned for decommissioning (713 acres of NFS system roads and 1,164 acres of unauthorized roads). These roads would remain on the landscape as unproductive sites and as chronic sources of sediment to stream courses. Existing open roads and unauthorized routes would likely continue to be used for motorized travel and would remain as chronic sources of pollution, including sediment to stream channels throughout the Rim Country area, especially where the roads are poorly located in stream bottoms or hydrologically connected to stream courses or have inadequate stormwater control or drainage.

Absence of Rock Pits and In Woods Processing Sites

Alternative 1 would have slightly more potential of increased sediment delivery to waterbodies than the action alternatives since road improvements proposed under the action alternatives would not occur. Selection of alternative 1 would mean that road improvements from previous approved NEPA decisions would continue to occur at existing levels, which are currently insufficient to maintain road infrastructure adequately. Roads would therefore continue to serve as chronic sources of sediment to stream courses and downstream waterbodies.

Expansion of rock pits under the action alternatives constitutes an irreversible and irretrievable commitment of resources since productive land is permanently altered and converted to an unproductive status and soils are permanently altered from their in-situ condition through overburden removal and extraction of rock for road surfacing. Irreversible is a term that describes the loss of future options. It applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity, that are renewable only over long periods of time. Irretrievable is a term that applies to the loss of production, harvest, or use of natural resources. Rock extraction limits future options for use of the converted sites and for of the material extracted. The no action alternative would mean that 29 acres of rock pit expansion would not occur, thereby eliminating this irreversible and irretrievable commitment of natural resources.

Alternative 1 would eliminate the need for 12 wood processing sites (128 acres). Activities such as drying, debarking, chipping stems and bark, processing and sorting logs to size, scaling and weighing logs and creating poles from suitable sized logs would therefore not occur. These sites constitute an irretrievable commitment of soils and vegetation resources since they remove soils and vegetation from productive status for several years while the sites exist. Selection of alternative 1 would eliminate the need for this irretrievable commitment of soils and vegetation resources.

Effects Common to Both Action Alternatives

Upland Vegetation Treatments

Potential effects of the action alternatives on soil productivity would include localized soil compaction, puddling, displacement, erosion, loss of soil organic matter, short-term changes in soil moisture content or retention, changes in nutrient cycles, changes in soil fauna, and introduction of invasive and noxious weeds. These effects can result from both mechanical and non-mechanical vegetation treatments (such as, forest thinning), mechanical and non-mechanical piling of activity-related debris, and temporary road construction and maintenance activities necessary to support mechanical vegetation treatments.

Mechanical forest vegetation treatments have the potential to adversely affect water quality through introduction of sediment and additional nutrients from decomposing woody debris, particularly where mechanical vegetation treatments occur in areas adjacent to stream courses. Mechanical treatments would largely avoid biological soil crust areas mapped areas due to the low site quality for woody biomass that will need treatments.

Soil compaction, puddling and displacement would primarily be limited to the transportation systems and high traffic areas within mechanical vegetation treatments such as existing National Forest System roads, temporary access roads, skid trails, log landings, debris piling areas, and areas where fireline construction occur. Road closures and curtailment of mechanical vegetation treatments during wet weather conditions and designation of authorized access routes (skid trails and temporary roads) and log landings prior to project implementation would minimize adverse effects to soil productivity caused by these activities.

The effects of the proposed forest restoration activities on erosion and sediment yields depend on methods and equipment used, skills of the equipment operators and personnel conducting the treatments, site-specific conditions, storm event timing and intensity, and prescribed fire locations and burn severities.

The risk of short-term accelerated soil erosion would be highest in areas where forest thinning and use of prescribed fire results in soil disturbance or complete removal of vegetative ground cover. These areas are expected to include skid trails, log landings, temporary access roads, obliterated roads, installed firelines and fuels treatment areas to support prescribed burning efforts, and National Forest System roads.

The removal of forest cover can decrease raindrop interception and evapotranspiration, which can increase water yields from treated areas (Bosch and Hewlett 1982, Stednick 1996). In areas where the annual precipitation is less than 20 in (500 mm), removal of the forest canopy does not typically increase annual water yields (Bosch and Hewlett 1982). The decrease in interception and transpiration caused by forest thinning is usually offset by the increase in soil evaporative losses, resulting in no net change in runoff as long as factors affecting runoff processes are not changed (for example, soil compaction which causes a shift from subsurface flow to overland flow) (MacDonald and Stednick 2003).

Evapotranspiration rapidly recovers with vegetative regrowth in partially thinned forests. Increases in runoff due to thinning operations rarely persist for more than 5 to 10 years (Robles et al. 2014, Cram et al. 2007).

Thinning of forest cover on soils currently characterized as unsatisfactory would improve soil conditions over the long-term by improving soil moisture and allowing greater sunlight penetration to the forest floor (for example sunflecks) resulting in an increase in grasses, forbs and shrubs in the forest understory where litter is currently the dominant soil cover (Griffis et al. 2000). The increased herbaceous vegetation would reduce soil erosion rates by providing vegetative ground cover that would intercept rain before it can reach soil surfaces and detach and entrain soil particles in runoff. Woody debris from forest thinning (slash) would be lopped and scattered where doing so would not result in excessive fuel loads, further mitigating potential adverse effects to soils and watershed resources. Finer litter and woody debris that is incidental to forest vegetation treatments (needles, leaves, twigs, cones, bark, etc.) would also remain on the ground following mechanical treatments to protect soil surfaces from wind and water erosion.

Cable Operations

Timber harvesting using cable operations equipment and techniques would have a reduced impact to the hydrological and soils resources from a potential 15 to 20 percent detrimental soil disturbance to four percent. This is based on numerous post soil disturbance surveys and personal experience over the past twenty years throughout the western United States. The size of landings could be larger to accommodate full tree removal and based on site specific logistics such as using existing roads as temporary roads. The percentage of soil compaction would be greatly reduced compared to ground-based harvesting treatments as that equipment could have more soil compaction potential. National Core Best Management Practices Veg-5 Cable Operations (USDA Forest Service 2012b) would be used to minimize potential upland soil erosion and sedimentation into stream channels and damage to residual boles post-harvest.

Prescribed Fire

Prescribed fire has the potential to affect water quality by increasing sediment, dissolved solids, and nutrients in streams. Dissolved nutrients in stream flow primarily originate from weathering of parent materials and soils, decomposition of plant material and other organic matter, and anthropogenic sources. Vegetative communities accumulate and cycle nutrients (Tiedemann et al. 1979, 1987). Fire can disrupt nutrient cycling and cause nutrient volatilization, leaching, and transformations. When vegetation is consumed by fire, some of the soil and organic matter nutrients such as nitrogen, phosphorus, copper, iron, manganese, and zinc are volatilized and lost from the system, while other nutrients such as calcium, magnesium, and potassium are converted into oxides and accumulate in ash (DeBano et al. 1998).

The mobility and concentration of nutrients in soils determines whether or not nearby water sources are at risk of contamination when prescribed fire is used. Nitrate is highly mobile and is therefore subject to risk of being leached from burned areas and transported to either surface or ground water. Phosphorus adsorbs readily to sediment and organic materials. Thus, phosphorus is usually transported to streams and water bodies through soil erosion. Rates of soil erosion and phosphorus contamination are generally dependent on soil characteristics and topographic relief of the site.

Prescribed fire has the potential to alter short- and long-term soil productivity and moisture content by changing the amount and type of vegetation, the amount of forest floor organic matter, and surface soil texture and wettability (O'Donnell et al. 2014). Prescribed fires typically leave greater amounts of organic matter (duff, forest litter, and large and small woody debris) on soil surfaces than uncontrolled fires. These materials serve as nutrient sinks, prevent soil particle detachment caused by raindrop impact, and capture sediments that would otherwise be transported to stream channels and waterbodies. Following low-severity prescribed fires, an increase in grasses and other herbaceous vegetation often occurs. This rapid regrowth of ground cover further immobilizes nutrients in plant material.

Prescribed fires that remove large amounts of vegetation from a site have potential to alter watershed hydrology. As vegetation is removed, evapotranspiration in the watershed decreases, thus providing greater stream flow and overall water yield within the watershed. Water uptake from trees is species-specific. Conifers, which are the dominant vegetation type throughout the Rim Country analysis area, generally transpire greater quantities of water than hardwoods such as oaks and aspen. Dense foliage and longer growing seasons promote the higher overall water uptake in conifers. Additionally, conifers have relatively dense crowns that intercept rainfall and allow for greater evaporative losses.

Once a site has undergone loss of vegetation and removal of the litter layer, surface water can cause erosion problems and result in higher stream discharges. Fires not only consume portions of the litter layer, but at high temperatures fires can also cause hydrophobic soil conditions (water repellent soils), thus making soils more susceptible to erosion. DeBano and Krammes (1966) and Robichaud (2000) observed that water repellency was dependent on the heating temperatures of the soils. At typical wildfire soil profile temperatures (less than 500 °F) when the soil was dry, soil hydrophobicity occurs at shallow depths (less than 1 inch). When soils are moist (conditions that commonly occur during prescribed fire in the spring and fall), soil hydrophobicity was less pronounced and only occurred after long heating times which would typically only occur during smoldering fires. Therefore, soil hydrophobicity under a prescribed fire scenario would likely be minimal in most cases.

Fire in southwestern ponderosa pine forests has been shown to generally increase soil moisture content (Ryan and Covington 1986, Ower 1985, Haase 1986). In a review of literature, Hungerford and others (1991) reported that burning can kill many kinds of bacteria, fungi and arthropods but the extent of this effect is dependent on the amount of heat generated by the fire and soil moisture content. To what extent these changes result in an impairment or degradation of soil productivity is not clearly understood. Hungerford suggests that low to moderate intensity prescribed fires may have minimal long-term negative effect on soil microorganisms. Kaye and Hart (1998) found that microbial nitrogen transformation rates increased under restored forest conditions, relative to the controls, suggesting higher microbial activity in the restored areas. Neary and others (1999) caution against the adverse effects to soil microorganisms caused by fires that become intense or are too frequent. Researchers have recommended maintaining soil carbon pools to maintain biologic activity (Stark and Hart 1997), and recommend maintaining heterogeneity in burned areas to provide suitable sites from which the microflora and microfauna can reestablish in burned areas (Moldenke 1999).

Prescribed fires proposed under the action alternatives are expected to be dominantly low soil burn severity with small areas of medium and high soil burn severity, retaining unburned islands and creating a mosaic of fire effects. Low and medium severity fires burn only a portion of the surface organic matter – leaving adequate soil cover over much of the burned area. In general, low severity prescribed fire does not cause excessive erosion or sediment transport since some soil cover is retained in a discontinuous pattern across the landscape. This type of prescribed fire would not have a long-term adverse affect on soil moisture content or biota. The increase in understory vegetation would improve long term soil structure

and porosity through increased fine root volume and vegetative litter, which are important habitat components for soil fauna that then incorporate organic matter into soil profiles and facilitate nutrient cycling. Prescribed burns are considered beneficial to biological soil crust habitat due to low amounts of vegetation burning at a no or low burn severity.

Installation of firelines where they do not currently exist would expose soil surfaces, increasing the risk of erosion by both wind and rain. Areas of high-severity fire may consume forest floor organic matter, leaving soil surfaces hydrophobic (repellant to water) and susceptible to erosion. Initially, the greatest risk of soil erosion would be expected to occur in areas where prescribed fire is implemented prior to forest thinning treatments. This is due to greater amounts of woody debris on the ground, higher stand densities and crown bulk densities at these locations, resulting in increased risk of high-severity fire. Rehabilitation of firelines installed during prescribed burning would minimize adverse affects to soil productivity from fireline installation. Implementing prescribed burning under conditions that would minimize high-severity fire would minimize areas where soil organic matter is totally consumed and prevent hydrophobic soil conditions.

Piling of activity-related debris (slash) would disturb soil surfaces, exposing them to direct raindrop impact and wind. On steep terrain this would increase localized, short-term erosion rates in areas where pile burning is conducted. These areas would constitute a very small percentage of overall treatment area (10 to 15 percent), so these effects are expected to be minor. Use of appropriate design features and best management practices as outlined in appendix C would mitigate most adverse effects from piling of woody debris created during forest thinning operations. Additionally, use of excavators with hydraulic bucket thumb attachments would minimize soil disturbance resulting from machine piling more effectively than dozer piling.

Burning of slash piles has been shown to negatively affect soil biotic and chemical properties due to intense soil heating (Korb et al. 2004 and Seymour and Tecle 2004). It can result in soil sterilization, increased erosion risk and an increased risk of invasive and noxious weeds that displace native vegetation. Pile burning sites would constitute a very small portion of the project area (less than 10 percent). Employing piling techniques that would minimize soil burn severity (such as rack-and-pile technique) whereby the pile is elevated on a grid of logs would reduce soil of these sites for the presence of invasive or noxious weeds following pile burning, and treatment of any infestations found would mitigate most adverse effects to soils caused by pile burning of slash.

Soil organic matter serves as the long-term nutrient supply for all vegetation occupying a site. It also provides microhabitat for most soil organisms and improves soil chemical and physical properties including soil aggregate stability, increased porosity, improved water holding capacity, lower bulk densities, and nutrient cycling. Initially, there would be an expected short-term increase in soil organic matter as a result of mechanical vegetation treatments as fine litter and woody debris are deposited on soil surfaces during treatments. Forest thinning would also allow greater light penetration to soil surfaces resulting in warmer soil temperatures. The reduction in tree vegetative cover as a result of forest thinning would decrease overall evapotranspiration rates from trees, but this is typically offset by increased evapotranspiration of understory herbaceous vegetation within a few years following treatment. Warmer soil temperatures would result in increased soil biological activity. Increased soil biological activity results in a proportional decrease in soil organic matter as organisms consume soil detritus. The eventual increase in understory vegetation would result in increased litterfall and deposition of organic matter onto soil surfaces. Broadcast prescribed fire would result in rapid oxidation of surface organic matter and living understory biomass, causing a release or transformation of some soil nutrients. Over time, a balance would occur between soil organism activity and soil organic matter content. This balance is readjusted

whenever fire is reintroduced. Low severity fire typically results in beneficial relationships between soil organism populations and soil organic matter content.

Runoff from road surfaces can detach and transport the fine material from road prisms and ditches. Sediment delivery directly from road surfaces to water courses is difficult to estimate since it occurs as non-point runoff. Sediments delivered to streams from roadside ditches may have originated from sheet or rill erosion prior to entering road surfaces or drainage ditches. In the absence of vehicle traffic, sediment concentrations in road runoff decreases over time. However, vehicle traffic, particularly trucks, can pulverize road surface aggregates, resulting in more fine particles that are easily transported in runoff. Additionally, the pressure of vehicular tires on saturated road surfaces can force fine particles from below the surface to move upward to the surface (Truebe and Evans 1994). Road proximity and connectivity to drainages can strongly influence sediment delivery to watercourses and peak flows in streams. Roads within the project area intersect numerous ephemeral drainages. These points of intersection occur as both culverted crossings and low-water crossings. Road-stream intersections are the primary location where sediments are delivered to stream courses.

Temporary Road Construction and Road Improvements

Temporary road construction constitutes an irretrievable commitment of soils and vegetation resources to a project. This is because they commit soils to nonproductive status for the duration of the road's existence and for several years afterwards, soil profiles are permanently altered from the *in-situ* conditions, and vegetation (timber and forage) is removed from the traveled way. However, temporary roads are not an irreversible commitment of these resources, since soils eventually return to productive status after the road has been decommissioned and vegetation, including trees, typically returns to the road corridor.

Temporary roads are built to minimal standards related to horizontal alignments and vertical grades results in roads that has less environmental impact with less cutting and filling. Also, temporary roads are not generally compacted to same standard as permanent roads, no roadside clearing, minimal width widths, etc.

Both action alternatives will require installation of temporary roads. Alternative 2 would require approximately 330 miles of temporary roads to access areas for mechanical vegetation treatments, while alternative 3 would require 170 miles of temporary roads.

Depending on temporary road locations and timing of use, these roads can adversely affect soil productivity for the duration of the road use and for several years following decommissioning and abandonment. Design criteria and best management practices in appendix C would limit adverse effects of temporary roads by preventing them from being located in sensitive areas (aquatic management zones, near spring ecosystems, and in riparian habitats) except where designated stream crossings are necessary. Upon decommissioning, temporary roads would be decommissioned pursuant to design features in appendix C. Temporary road building is likely to avoid biological soil crust mapped areas due to the lack of mechanical treatments in the surrounding locale.

Temporary roads are therefore expected to have minimal long-term effects to soil productivity, water quality, and vegetation and therefore watershed condition.

Existing system roads may be improved or realigned to provide serviceable and safe access for forest mechanical vegetation and prescribed fire treatments. These improvements will protect soil productivity and surface water quality by (a) preventing roadbed erosion through application of aggregate to provide a more stable and reliable running surface, (b) provide road drainage that prevents erosion and sediment

delivery to stream courses, and (c) reduce effects of stream crossings through improved road stream crossing designs.

Road Use

Approximately 5,127 miles of National Forest System roads would be needed to implement the Action Alternatives. Vehicle traffic associated with project implementation, particularly trucks, tend to pulverize road surface aggregates, resulting in more fine particles that are easily transported in runoff. Road proximity and connectivity to drainages can strongly influence sediment delivery to watercourses and alter flow regimes in streams.

It is likely that traffic associated with mechanical restoration treatments and commercial timber sales would have short-term adverse effects to surface water quality through sediment delivery to stream courses and other water bodies and increases in turbidity. Use of Resource Protection Measures and applicable road best management practices would minimize and mitigate most adverse effects from road use, but would not eliminate them entirely. As previously noted, forest roads are typically one of the major sources of surface water quality degradation from forest operations.

Once mechanical treatments are completed and transportation of forest products and machinery no longer occur on a given road, adverse effects to water quality typically diminish and return to background level proportional to historic road use levels.

Road Decommissioning

Approximately 490 miles of poorly located and **unneeded** system roads would be decommissioned under the action alternatives (200 on the Coconino National Forest and Apache-Sitgreaves National Forest and 290 miles on the Tonto National Forest). Additionally, approximately 800 miles of unauthorized roads would be decommissioned on the Apache-Sitgreaves and Coconino National Forests.

Road decommissioning activities would vary depending on road locations, conditions, and effects to other resources (such as soils water quality and watershed condition). The activities range from blocking the entrance, scattering boughs on the roadbed, revegetating and water barring, to removing fills and culverts, reestablishing drainage-ways, pulling back shoulders, and recontouring the slopes for full obliteration. These activities would return unproductive or marginally productive soils to a more stable, productive status over the long term by improving water infiltration and vegetative ground cover and reducing erosion hazards. Stream crossings would be returned to a more natural condition, thus reducing runoff and sediment delivery into ephemeral stream channels or intermittent or perennial waterbodies. Adverse effects to surface water quality caused by stormwater runoff from road surfaces would also be minimized. Modeled erosion rates of roads are, to a large degree, at or above tolerance erosion rates.

Use of residual woody debris from mechanical timber harvest (such as slash) or fuels reduction treatments for closing roads is a common practice for road decommissioning. However, this practice rarely improves hydrologic function where roads have interrupted or redirected surface flows via ditches and cross drain culverts, road surfaces are severely compacted, or have channelized flow in the existing roadbed. Additionally, slash can be burned in wildfires and prescribed fires, leaving roads essentially reopened to unauthorized use. Slash alone does not appreciably contribute to native plant propagation within retired roadbeds. While slash can be used as a tool to prevent road use, it should be one component in a suite of road decommissioning practices described above that result in a more naturalized condition upon completion of road decommissioning.

Road decommissioning improves watershed condition by reducing open road densities within affected watersheds. Reducing the number of roaded miles per unit area of watershed reduces hydrologic impacts that roads have on that watershed. Hydrologic impacts such as stream crossings and hydrologic diversions that result from road ditches, cross drainages, etc. are therefore reduced. Road decommissioning typically results in improved soil productivity and water quality (Sosa-Perez and MacDonald 2017).

Rock Pits and Wood Processing Sites

Rock Pits

As previously noted, expansion of rock pits under the action alternatives constitutes an irreversible and irretrievable commitment of 29 acres of soils, and geologic resources since productive land is permanently altered from its natural condition and converted to an unproductive condition in perpetuity and through the extraction of rock for road surfacing. Irreversible is a term that describes the loss of future options. It applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity, that are renewable only over long periods of time. Irretrievable is a term that applies to the loss of production, harvest, or use of natural resources. Rock pit expansion limits future options for use of the converted sites and rock extraction eliminates future options for use of the extracted material. Both action alternatives would mean that 29 acres of rock pit expansion would occur, thereby making an irreversible and irretrievable commitment of natural resources.

In-Wood Processing Sites

The action alternatives would include 12 wood processing sites totaling 128 acres. The criteria for selection of sites suitable for wood processing included the following: flat uplands having less than 5 percent slope, more than 200 feet distance from ephemeral and intermittent stream channels, and more than 300 feet from meadows and springs. These design criteria, in addition to applicable Resource Protection Measures, would reduce the potential for adverse effects to surface water quality, stream channels, riparian resources, and spring ecosystems. However, these sites constitute an irretrievable commitment of soils and vegetation resources since soils would be committed to nonproductive status for the duration of each wood processing site's existence and vegetation removal would be required for establishing sites, reducing the areal extent of available forage or forest cover. The scale of this irretrievable commitment of soils and vegetation resources for the establishment of wood processing sites in the context of the total project area is minimal at 128 acres and would not likely have detectable adverse effects at the watershed scale.

Riparian, Spring and Stream Restoration

Comprehensive restoration activities included in the action alternatives and described in the Aquatic and Watershed Condition-based Management would directly improve stream channel morphology, riparian and slope wetland conditions, floodplain functionality and spring ecosystems. Restoring stream channel gradients and increasing channel sinuosity, restoring width-to-depth ratios and reconnecting stream channels to their historic floodplains would improve hydrogeological conditions at the watershed level. Surface flows, floodplain water storage, and sediment transport would all be improved. Activities such as installation of grade control structures has been shown to be effective for dissipating runoff energy, improving sediment storage, aggrading incised stream channels and reconnecting them to historic floodplains. Wet meadows would be effectively restored through implementation of these, and similar practices that eliminate single-thread streams and gullies that are drying out these wetlands. Planting native herbaceous riparian species, stabilizing stream banks, reducing bank steepness of entrenched

channels and reconstructing riffle and pool formations would contribute to improved hydrologic function of stream channels.

Since upland restoration actions (such as, forest thinning and prescribed fire) could have a cumulative effect on restoration of riparian areas, springs and streams, it is imperative that upland restoration actions are staged in a manner that compliments comprehensive restoration activities. Upland restoration treatments are expected to produce varying levels of runoff and sediment delivery to riparian areas such as wet meadows and riparian stream corridors as well as stream channels themselves. Currently these areas are sediment deprived, meaning historic sediment loads originating from wildfires are absent. This combined with historic overgrazing has resulted in gully and channel formation in meadows and incision of stream courses. Conducting comprehensive restoration treatments prior to upland restoration actions would allow for sediment to deposit as alluvium where desired, rather than being transported through the system in a manner that increases surface scour. If staged optimally, upland restoration treatments combined with comprehensive restoration treatments would provide the greatest benefit to watershed condition through improved sediment capture and utilization, improved surface water quality through reduced suspended sediment loads, and nutrient storage and filtering in riparian areas.

There would likely be short-term, adverse effects to surface water quality through implementation of these restoration actions since they are often in-channel restoration practices, occur in wetland areas, or are in riparian areas immediately adjacent to stream channels and wetlands. With implementation of **design features**, Resource Protection Measures and best management practices, adverse effects can be minimized or mitigated. Native riparian and wetland vegetation is expected reestablish in these areas soon after restoration activities are completed (1 to 3 years). In some areas, reestablishment of wetland or riparian vegetation would be hastened by planting of appropriate wetland or riparian herbaceous and woody species. Installation of protective exclosures around restored sites would reduce browsing and trampling by both domestic and wildlife ungulates.

Effects Unique to Each Action Alternative and Differences among Them

Mechanical Forest Restoration Treatments (Thinning)

One of the primary differences between Alternative 2 – Modified Proposed Action and Alternative 3-Focused Restoration is the number of acres and intensity of mechanical forest restoration treatments. Alternative 2 proposes to mechanically thin trees and/or implement prescribed fire on up to 991,060 acres, while alternative 3 would mechanically treat slightly more than half (55 percent) of those acres at 528,850 acres. Alternative 2 addresses landscape-scale mechanical forest restoration across the majority of the Rim Country analysis area more effectively than alternative 3. Alternative 3 is designed to focus restoration treatments in areas that exhibit the greatest departure from the natural range of variation of ecological conditions, and/or that put communities at risk from undesirable fire behavior and effects. Therefore, alternative 3 would leave the greatest number of acres that are moderately departed from desired ecological conditions and would benefit from mechanical restoration treatments to restore forest vegetation health and resilience.

Alternative 2 - The Modified Proposed Action

Since alternative 2 would provide the greatest areal extent of forest mechanical restoration treatments, it would correspondingly result in a higher proportion of acres that are resilient and fire adapted. As a result, alternative 2 would improve soil and watershed condition to a much larger degree than alternative 3.

The greater number of acres that would be treated mechanically also means there would be a corresponding increase in short term adverse effects to soils, water quality and watershed condition. With

the higher number of acres to be treated mechanically, adverse effects such as soil compaction, puddling, displacement, erosion, loss of soil organic matter, short-term changes in soil moisture content or retention, changes in nutrient cycles, changes in soil fauna, and risk of introduction of invasive and noxious weeds are likely. The extent and locations of such effects cannot be predicted with accuracy, although some generalizations can be made. Mechanical forest vegetation treatments under alternative 2 would require more disturbance through construction of temporary roads and road use (330 miles of temporary roads under alternative 2 versus 170 miles of temporary roads under alternative 3), and more log landings and skid trails. More frequent road maintenance would be required since there would be substantially more truck traffic under alternative 2 than alternative 3.

As previously noted, soil compaction, puddling and displacement would primarily be limited to the transportation systems and high traffic areas within mechanical vegetation treatments such as existing National Forest System roads, temporary access roads, skid trails, log landings, and debris piling areas.

At the watershed scale, it is possible that the greater areal extent of mechanical vegetation treatments under alternative 2 would result in increased water yield from watersheds where large percentages of the watershed are mechanically treated in a short timeframe. However, any increases in water yield would be short lived (5 to 10 years) since understory vegetation would increase and the water uptake by grasses, forbs and shrubs and warmer soil temperatures would soon offset evapotranspiration lost from forest thinning.

Forest thinning on soils currently characterized as unsatisfactory would improve soil conditions over the long term by improving soil moisture and allowing greater sunlight penetration to the forest floor (such as sunflecks) resulting in an increase in grasses, forbs and shrubs in the forest understory where litter is currently the dominant soil cover.

Alternative 3 – Focused Restoration

Alternative 3 would result in substantially fewer acres being treated mechanically. There would therefore be correspondingly fewer acres that would exhibit adverse effects from mechanical forest restoration treatments such as soil compaction, puddling, displacement, erosion, loss of soil organic matter, short-term changes in soil moisture content or retention, changes in nutrient cycles, changes in soil fauna, and risk of introduction of invasive and noxious weeds. Adverse effects to surface water quality would also be reduced under alternative 3. However, over the long term, there would be a much greater number of acres that would remain departed from vegetation and fuels desired conditions. These areas would likely remain at risk of high-severity wildfire due to high fuel load levels.

Prescribed Fire

Alternative 2 – Modified Proposed Action

Alternative 2 proposed substantially more acres of prescribed fire than alternative 3. Prescribed fire has the potential to impact soil productivity and surface water quality by increasing soil erosion rates and delivery of sediment, dissolved solids, and nutrients to streams and other waterbodies. Since more acres would be treated with prescribed fire under alternative 2, it is reasonable to expect that there would be greater areal extent of short-term adverse effects to soil productivity and water quality and therefore watershed condition. However, adverse effects of prescribed fire on soils, water quality and watershed condition would not be nearly as great as an uncontrolled wildfire.

Prescribed fire has the potential to alter short- and long-term soil productivity and moisture content by changing the amount and type of vegetation, the amount of forest floor organic matter, and surface soil

texture and wettability. Prescribed fires typically leave greater amounts of organic matter (duff, forest litter, and large and small woody debris) on soil surfaces than uncontrolled fires. These materials serve as nutrient sinks, prevent soil particle detachment caused by raindrop impact, and capture sediments that would otherwise be transported to stream channels and waterbodies. Following low-severity prescribed fires, an increase in grasses and other herbaceous vegetation often occurs. This rapid regrowth of ground cover further immobilizes nutrients in plant material.

The mobility and concentration of nutrients in soils determines whether or not nearby water sources are at risk of contamination when prescribed fire is used. Fire can disrupt nutrient cycling and cause nutrient volatilization, leaching, and transformations. When vegetation is consumed by fire, some of the soil and organic matter nutrients such as nitrogen, phosphorus, copper, iron, manganese, and zinc are volatilized and lost from the system, while other nutrients such as calcium, magnesium, and potassium are converted into oxides and accumulated in ash (DeBano et al. 1998).

Prescribed fires can adversely affect watershed hydrology. As vegetation is removed, evapotranspiration in the watershed decreases, thus increasing stream flow and overall water yield within the watershed. The increase in water yield may result in a corresponding increase in sediment and nutrient loads in surface waters.

Trends indicate that fuel loading would continue to increase in areas that are not thinned mechanically. Increased fuel loads would be in the form of both living forest vegetation and woody detritus. Ingrown forest conditions would facilitate the existence of ‘ladder fuels’ which allow ground fires to ascend into the canopy and spread quickly as crown fires.

High severity wildfires tend to occur in areas where fuel loading and fuel distributions are sufficient to carry a fire. Typically, uncontrolled wildfires occur during the drier times of the year, yielding higher severity fires than would occur under prescribed fire conditions. The adverse effects of a high-severity fire, such as the loss of forest floor organic matter, increased soil erosion, and changes in soil biota would be more widespread in an uncontrolled wildfire than under prescribed fire conditions where the size and intensity of the fire can be controlled. The primary impact of high-severity wildfire on soil productivity is the removal of surface organic matter, exposing soils to erosion by wind and rain. If surface organic matter is reduced (as happens with a high-severity wildfire) the cation exchange capacity, a measure of soil fertility, is also reduced and the ability of the soil to retain nutrients leached from ash decreases.

Alternative 3 – Focused Restoration

Alternative 3 would result in substantially fewer acres being treated with prescribed fire. There would therefore be correspondingly fewer acres that would exhibit adverse effects from prescribed fire restoration treatments as detailed in alternative 2 above. Over the long term, there would be a much greater number of acres that would remain departed from vegetation and fuels desired conditions. These areas would likely remain at risk of high-severity wildfire due to high fuel load levels.

Cumulative Effects

Cumulative effects include the impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other action (40 CFR § 1508.7). The geographic setting for the cumulative effects analysis for soils and watersheds includes all the 6th level (HUC-12) hydrologic unit subwatersheds that include Rim Country project area, which comprises approximately 2.7 million acres. The timeframe for past actions is 10 years, based on soil productivity, vegetative response, and coarse woody debris recovery within treated areas. Surface disturbing activities

that are older than 20 years are assumed to be contributing negligible or no measurable cumulative effect within the analysis area.

Alternative 1 – No Action

The no action alternative would result in no additional mechanical forest vegetation or prescribed fire treatments, no additional road construction, realignment or decommissioning, no additional spring or riparian restoration, no stream channel restoration, no rock pit expansion, and no wood processing site beyond what has been planned under separate NEPA analyses. Therefore, there would be no cumulative effects to soils or watershed condition as a result of alternative 1 beyond those already planned or being implemented under separate NEPA decisions. As can be seen in appendix G of the Soils and Watershed Specialist's report, the majority of past, present, and reasonably foreseeable future actions consist of forest restoration and fuels reduction treatments. Other restoration actions such as grassland and meadow restoration, spring restoration, and fire rehabilitation are occurring, have occurred in the past or may occur in the future. Restoration projects are designed to improve forest and grassland vegetation conditions and therefore contribute to improved soil and watershed condition.

A cumulative effect of the no action alternative includes ongoing erosion and sediment delivery to ephemeral channels from roads proposed for decommissioning under the action alternatives that would not be obliterated under this alternative. When combined with other activities in the proposed project area, sediment production from these roads could contribute to adverse effects to downstream surface water quality if these roads remain in an unstable, eroding condition.

When combined with past, present, and reasonably foreseeable future actions, the no action alternative would not contribute to appreciable improvement in soils or watershed conditions in watersheds that encompass the Rim Country analysis area.

Alternative 2 – Modified Proposed Action

Mechanical Forest Restoration Treatments, including Timber Harvesting

Soil Stability and Erosion Processes

Proposed meadow and riparian restoration and stream channel restoration will improve soil stability, nutrient cycling, vegetative cover, and hydrologic processes and therefore watershed condition. Cumulative effects of alternative 2, in combination with past, present, and reasonably foreseeable future action includes meadows (slope wetlands) that are storing water and recharging groundwater systems, stable against extreme runoff velocities and therefore less prone to headcutting and gully formation. Sediment delivery to stream courses would be greatly reduced and would return to historic, or background levels due to reduced fire burn severity, improved vegetative cover of native perennial grasses and forbs.

Poorly located roads proposed for decommissioning are, in some cases acting in a similar manner as gullies, channelizing runoff into ephemeral and intermittent drainages and other waterbodies. Decommissioning of 490 miles of system roads and 800 miles of unauthorized routes would contribute to improved watershed condition at the landscape scale through reduction of roaded miles per unit of land area, leading to greater areal extent of naturalized watershed condition. When combined with other past, present, and reasonably foreseeable future actions, road decommissioning under alternative 2 would improve watershed condition throughout most of the project area more effectively than is currently occurring under the no action alternative or would occur under alternative 3.

Nutrient Cycling

Soil nutrient cycling would progress toward desired conditions as tree litter layers (thick layers of pine needles) are replaced with vegetative cover and fine litter. Fine roots of grasses, forbs, and shrubs would improve soil aggregate stability, water infiltration, and decrease soil bulk densities. These conditions allow nutrients to translocate both vertically and laterally as water infiltrates and moves through soil matrices rather than being transported to water bodies in runoff.

Continued reintroduction of fire to these fire-dependent systems will result in progressively lower soil burn severities over time, resulting in only partial consumption and light charring of organic matter, resulting in more recalcitrant forms of organic matter that contribute to improve C:N ratios and incorporation of other nutrients (phosphorus, sulfur, potassium, etc.) into upper soil horizons.

Soil Hydrology

Historic evidence indicates that existing landings, skid trails, and roads constitute approximately 5 to 10 percent of the total project area. As previously noted, roads proposed for obliteration tend to be compacted and rutted and are often channelizing surface runoff to surface waters and are not exhibiting substantial recovery. To mitigate any additional compaction and displacement of soils, temporary roads, skid trails, and landings would be stabilized using Resource Protection Measures and BMPs, which may include ripping or decompacting and seeding to alleviate reductions in porosity and infiltration capacity. Therefore, it is not expected that the percentage of compacted areas would increase substantially (beyond an additional 1 to 2 percent over the current condition). Any soil compaction resulting from mechanical vegetation treatments would be ameliorated over time through pedoturbation caused by soil freezing and thawing and wetting and drying cycles, and root elongation.

Areas of water repellency, which form because of the prescribed fire use are expected to recover within 1 to 3 years as natural pedoturbation processes described above occur.

Watershed Response

When combined with other past, present, and reasonably foreseeable future projects, alternative 2 would be beneficial to watershed response. In the absence of maintenance treatments this benefit would decrease over time because of forest ingrowth that would increase evapotranspirational demand.

Recreational Activities

Recreational activities within the proposed project area include hiking, viewing wildlife, hunting, dispersed car-camping, backpack camping, orienteering, horseback riding, photography, picnicking, taking scenic drives, ORV/ATV use, bicycling, shooting, and gathering in family or social groups. Other common uses within the project area include firewood cutting, Christmas tree cutting, collecting boughs and cones, gathering antlers, and collecting food and medicinal resources such as berries, nuts, mushrooms, and medicinal plants. Of these, ORV/ATV use, dispersed camping, firewood collection and Christmas tree cutting have the greatest potential to result in adverse cumulative effects to soils through compaction, puddling, erosion, and displacement. These conditions would be limited to areas where such activities take place.

Restoration treatments will increase forest openings and provide more opportunity for recreational activities to be dispersed across the landscape rather than concentrated in a smaller number of areas. Dispersed recreation tends to have reduced impacts to soils, water quality and watershed condition in comparison to concentrated recreational use. In combination with past, present and reasonably foreseeable recreation activities, alternative 2 would improve soils and watershed condition throughout the Rim Country analysis area through improved vegetative ground cover which provides for sustainable nutrient

cycles and soil productivity, reduced erosion and sediment delivery to stream channels, and improved water quality and overall improved watershed condition.

Since alternative 3 will result in fewer forest openings than alternative 2, it is less likely to alter recreational patterns appreciably. Recreationists will continue to congregate in existing openings, resulting in excessive soil disturbance and loss of vegetative cover that reduce soil stability and hydrologic function. Soil erosion from such sites would likely continue to exceed tolerance thresholds.

Livestock Grazing

Currently, livestock grazing is authorized across most of the analysis area. While grazing results in discontinuous fuel patterns in grass, forb and shrub vegetative communities, it has not effectively reduced the densities in the ponderosa pine stands. As a result, excessive stand densities in the ponderosa pine vegetation type are causing a shift in understory vegetative communities toward more shade tolerant species such as bromes and mountain muhly.

Cumulative effects from livestock grazing when added to effects from restoration treatments would include minor, generally localized soil compaction, puddling, displacement and erosion from livestock trailing and in areas where animals congregate such as livestock waters and areas where mineral supplements are placed. Livestock trails make up a very small portion of the total project area and therefore have a negligible effect on soils or watershed condition. When added to the effects of the restoration treatments livestock grazing is not expected to increase the area of soils characterized as unsatisfactory within the cumulative effects area. Overall, in combination with ongoing livestock grazing and in the absence of increasing livestock numbers being grazed, alternative 2 would benefit soils and watershed conditions to a greater extent than alternative 3.

Invasive and Noxious Weeds

The cumulative effect of the increased risk of spread on noxious and **invasive weeds** on soil productivity can only be described in general terms because of the large number of unknown variables. Areas where soil disturbance includes compaction, displacement, erosion, and excessive heating are at the greatest risk of invasion by noxious weeds. These include temporary roads, areas where concentrated harvesting operations occur and pile burning sites. To minimize cumulative adverse effects of invasive and noxious weeds, observed infestations would be managed in accordance with the Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds Coconino, Kaibab, and Prescott National Forests (2005).

Fire Effects

In low burn severity areas, effects are mainly light ground char where the litter is scorched, charred, or partially consumed. The litter layer, or duff is largely intact, although it may be charred on the surface. Woody debris accumulations are partially scorched, charred, or consumed. Mineral soil properties are not adversely affected. In fact, low severity fire releases nutrients stored in surface organic matter and live vegetation. These nutrients facilitate rapid reestablishment of vegetative ground cover since root to shoot ratios are improved for grasses and forbs that survive fire, resulting in protection of soils from accelerated soil erosion soon after fire has occurred. Evidence of sheet and rill erosion as a result of low severity fire is typically very minor or nonexistent. In forested areas, much of the tree overstory is green with some scorch at the base of the trees and in the lower branches following low severity fire. Most trees survive; however, pockets of seedlings, saplings, and mature trees can be killed or consumed where moderate to high-severity fires occur. While most of the shrubs, forbs and grasses are affected under low severity fire conditions, in most cases, much of this vegetation survives. Areas identified as low burn severity may also contain large, unburned areas, resulting in a mosaic of burned and unburned conditions across the

landscape or within a subwatershed. When combined with other past, present, and reasonably foreseeable prescribed fire project, alternative 2 would have beneficial effects on soils and watershed conditions.

Cumulative Watershed Effects

In summary, cumulative watershed effects from implementation of the alternative 2 would include improved soils and watershed condition and restoration of the ecological interrelationships of soils, vegetation, and watersheds throughout the Rim Country project area. Streams, meadows, and riparian areas that depend on stable upland soils would be better protected from potential adverse effects of high-severity wildfire because of restoration treatments. The transportation system would provide necessary access for future management and would be more sustainable than the current transportation system. It is reasonable to expect that treatments resulting from implementation of the proposed action or other action alternatives would result in some short-term, localized negative effects due to soil disturbance caused by use of heavy machinery for mechanical forest restoration treatments (including commercial timber harvests), burning of piled woody debris, and broadcast prescribed fire (Debano 1998, Hungerford et al. 1991). These disturbances would also occur on soils where previously completed projects overlap proposed or future activities in watersheds across the project area, resulting in a cumulative effect to soils and watersheds. Short-term negative effects to soils, water quality, and watershed conditions, primarily through soil disturbance and loss of vegetative cover would be greater under alternative 2 than alternative 3. However, these effects would generally not persist beyond 3 to 5 years following each discrete disturbance. Since alternative 3 results in greater areal extent of areas that remain untreated, these areas will remain at risk of high-severity wildfire, concentrated recreational uses, and erosion and sediment delivery from roads that are not decommissioned. Alternative 2 therefore has greater long-term benefit to soils and watershed condition than alternative 3. However, no long-term, cumulative adverse effects from ground disturbance caused by mechanical thinning or prescribed fire (compaction, topsoil displacement, extensive areas of high soil burn severity, etc.) are anticipated to occur at a severity or spatial extent to negatively affect overall soils and watershed conditions. In general, proposed restoration treatments are expected to result in improvement in overall soils and watershed condition in proportion to the areal extent of the restoration treatments within each watershed.

Alternative 3 – Focused Restoration

Cumulative effects of alternative 3 would be similar to those of alternative 2, but would occur at a substantially reduced areal extent with regard to forest mechanical thinning and prescribed fire treatments. Add a one or two sentences that clarify the substantially reduced areal extent blurb.

Other restoration actions (stream channel restoration, spring restoration, road decommissioning, etc.) would be the same as alternative 2.

Silviculture

The silviculture analysis is summarized from the Silviculture Specialist report, which is incorporated by reference (USDA FS 2022).

Affected Environment

The cover types analyzed are limited to Aspen, Grassland/Meadow, Madrean Encinal Woodland, Madrean Pinyon-Oak, Mixed Conifer with Aspen, Mixed Conifer/ Frequent Fire, Pinyon-Juniper Woodland, Ponderosa Pine, and Ponderosa Pine/ Evergreen Oak and riparian for a total of 989,307 acres. For analysis purposes, the Madrean Encinal Woodland and Madrean Pinyon-Oak cover types **may** be combined into one category called Madrean Woodland due to limited acreage, data availability and similarity.

Of the 1,238,667 acres within the project area:

- Approximately 216,091 acres have been removed from this silvicultural analysis because they are part of an ongoing project or are being analyzed in a separate analysis (figure 5).
- Silvicultural treatments and their effects within these areas will not be analyzed in this section of the FEIS.
- Approximately 31,516 acres are either non-National Forest System lands, or are non-forested.
- An additional 1,752 of these acres identified as “Other” in table 5 were determined to be either surface water, mineral pits, dams or road surface and will not be given a detailed description in this silvicultural analysis.
- The remaining 989,307 acres, considered the analysis area, will be analyzed in this section of the FEIS.

The descriptions of the existing condition are organized under the criteria determined to be part of a properly functioning ecosystem. An ecosystem that is properly functioning is thought to be resilient to perturbations in structure, composition, and biological or physical processes. Systems at risk are those that may be degraded beyond the range of resiliency and sustainability. The four ecosystem characteristics discussed below are cover type, composition, structure, pattern, and processes.

Post-European Settlement Era Ecological Changes

Open, frequent fire forest structure has been altered by logging, grazing, and fire suppression and has led to overly dense forest structure and fire regimes highly departed from their desired conditions.

Large, old ponderosa pines and oaks have become underrepresented in some areas. The remaining large, old ponderosa pines are suffering increased mortality rates as a result of competition with small trees, insects and disease, and climate change.

Ponderosa pine forests have increased in density as abundant tree seedlings have regenerated in canopy openings and replaced some open, multiple age class forest structure with a dense and predominately single age class structure. This resulted from logging practices, protection from fire, grazing, and a relatively wet climatic cycle during the early part of the 20th century (Schubert 1974). In other areas, uneven-aged stand structure remains as a result of historical mechanical harvesting as well as natural disturbance.

Frequent low-severity fire regime forests have increased densities from shade tolerant and fire intolerant species. Dry mixed conifer forests are far denser and with a species composition that is not necessarily representative of their natural range of variation. Competition for moisture and nutrients is intense in currently dense stands, and results in stress that increases vulnerability to attack by insects such as pine bark beetles (*Dendroctonus* spp.) and ips beetles (*Ips* spp.) (Kane and Kolb 2014).

While experts think that the extent of dwarf mistletoe has increased only modestly, the abundance and intensity of infections have increased substantially across the project area (Conklin and Fairweather, 2010) due to closed forest conditions, lack of low severity fire, and lack of adequate mitigation management. This increased infection severity has been associated with decreased resilience to beetle- and drought-induced mortality (Kenaley 2008), reduced forest health and growth, accumulated ladder fuels (Conklin and Fairweather 2010), and negative effects from projected climate change.

Potential fire severity has changed from mostly low severity fire to mixed and high severity. The risk of stand replacing fires has increased. High severity fires often result in ecosystem conversions, increased soil erosion, loss of hydrologic function, and invasion by nonnative species. Stand-replacing wildfires within ponderosa pine ecosystems have resulted in conversion from forest to grass or persistent shrub for long periods or dense, even-aged structure. These areas would not again support old-growth forest structure for centuries. Trees have significantly encroached into historical grasslands and meadows.

Vegetation Composition

Vegetative composition refers to the vegetation cover types, species present and their relative abundance.

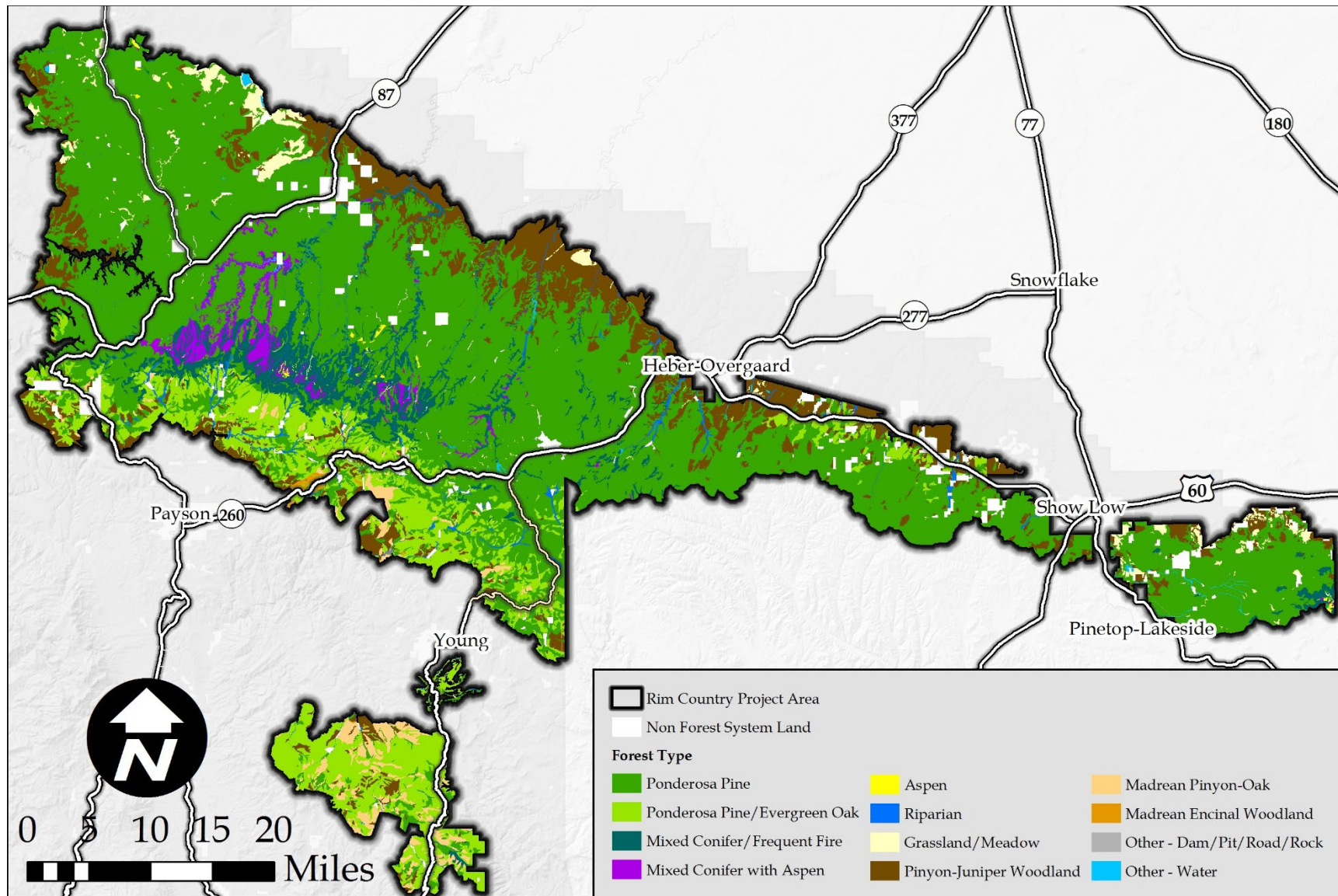


Figure 19. Existing condition – cover type

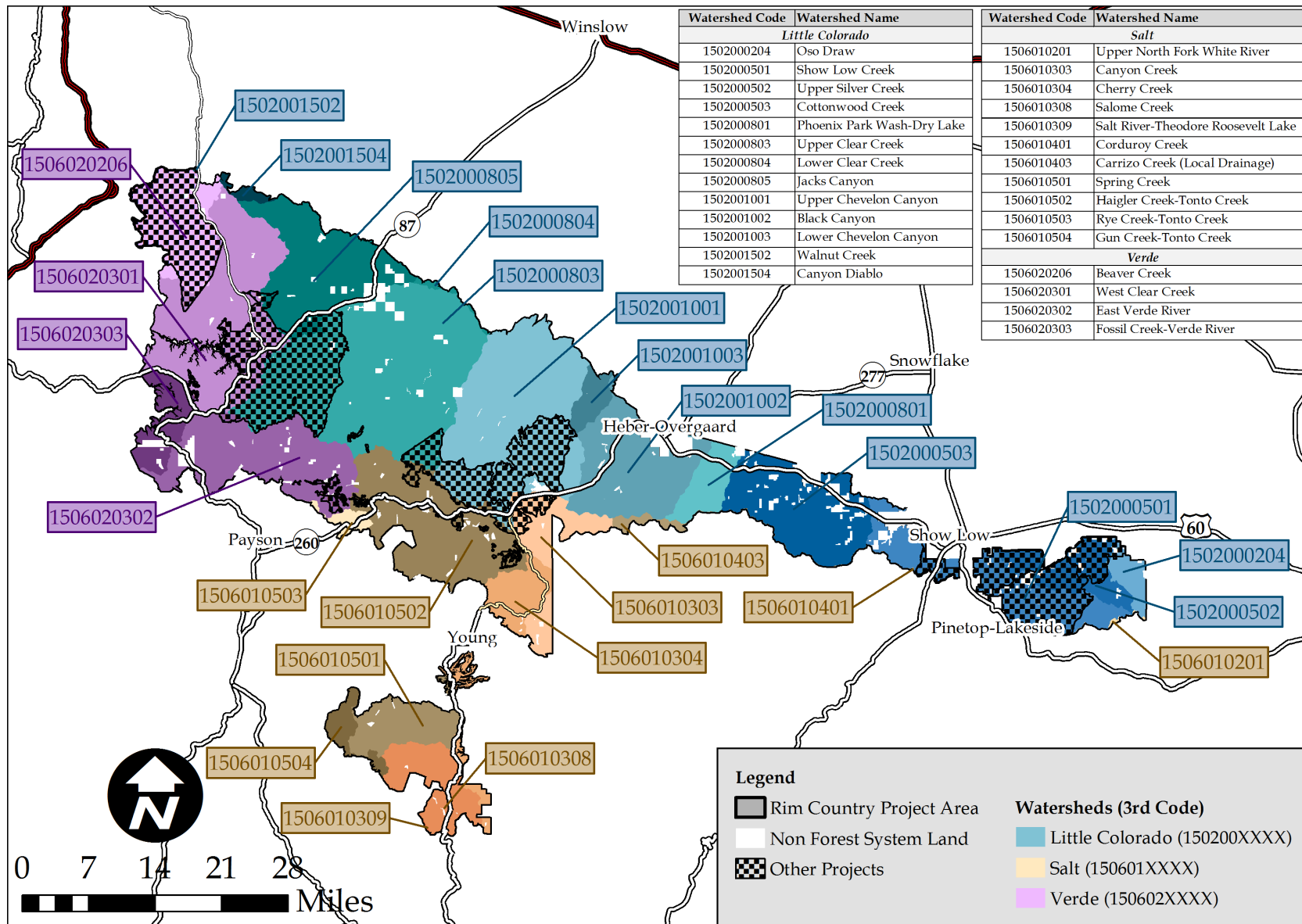


Figure 20. Existing condition – 5th HUC watersheds

Vegetation Structure

Uneven-aged Structure

Structure is a means to express the balance of age and size classes as well as the horizontal and vertical distribution of layers in the forest canopy. In a forested environment, vegetation structure can also include snags, down logs and woody debris, and canopy closure.

Uneven-aged forests are generally described as having three or more distinct age classes of trees (Helms 1998) and is a measure of vertical structure within a forest. Ponderosa pine is composed of trees in structural stages that range from young to old trees and are dominated by ponderosa pine. Currently, the arrangement of the tree cohorts (groups of trees of a similar age class) or size classes are in conditions conducive to crown fire with extremely dense and continuous overstory canopies in a closed condition and understory canopies acting as ladder fuels supporting a transition from surface fire to crown fire behavior. A size-class distribution of trees in the combined aspen, dry mixed conifer, ponderosa pine, ponderosa pine/evergreen oak and riparian cover types by 5th HUC watershed shows that the majority of trees are concentrated in the smaller size classes while the majority of basal area is concentrated in the 5 to 12 inch and 12 to 18 inch size classes.

Density

Overall, basal areas are high for most cover types, especially Aspen, Dry Mixed Conifer, Ponderosa Pine/Evergreen Oak, and Mixed Conifer with Aspen. Average basal area of ponderosa pine cover type across the analysis areas is lower, largely due to the number of ponderosa pine stands that experienced stand replacing fire in the Rodeo-Chediski Fire in 2002 and are now dominated by stands with low basal area.

Large Tree and Old Tree Structure

Ponderosa pine stands where the basal area of ponderosa pine trees greater than 18 inches is more than 40 square feet of basal area per acre area may be considered stands with an abundance of large trees (SALT stands). These stands occur outside of Mexican spotted owl protected activity centers, Mexican spotted owl Recovery habitat and wildland urban interface and are being identified for their distinctive forest structure. The presence of SALT stands is used as an indicator of old and large trees across the landscape. Additional information on SALT stands across 5th HUC watershed is provided in the Silviculture Specialist Report (USDA FS 2022).

More than a century of fire suppression, overgrazing by livestock, and unsustainable logging practices in southwestern frequent fire-adapted forests has lowered the numbers of large and old trees below reference conditions (Noss et al. 2006) and, coupled with a changing climate, has resulted in larger and more severe wildfires (Stephens et al. 2016). Recognizing that characteristic forests prior to the interruption of natural fire regimes had higher proportions of large and old trees than contemporary forests (Reynolds et al. 2013), forest restoration practices have focused on the need to reduce densities of small and young trees to restore low intensity fire (Agee and Skinner 2005, Reinhardt et al. 2008) and offset carbon losses resulting from uncharacteristically high-severity wildfires (North and Hurteau 2011). Large and old trees provide essential habitat for species like northern goshawk (Beier et al. 2008, Dickson et al. 2014, Reynolds et al. 2017), Mexican spotted owl (USDI FWS 2012), and Abert's squirrel (Keith 2003), as well as containing most of the carbon stored on the landscape (North et al. 2009). Large and old tree retention has been a fundamental component of southwestern frequent fire-adapted forest restoration since the earliest developments of science-based recommendations to guide restoration implementation (Moore et al. 1999, Allen et al. 2002).

Forest Process

Insects

A general bark beetle hazard model for southwestern ponderosa pine based exclusively on the tree density relationships developed in a *Dendroctonus* hazard model was validated by Chojnacky et al. (2000) The model indicates that stands of ponderosa pine within the analysis area with a relative density below 30 percent of SDImax have a low hazard rating and stands between 30 and 40 percent of SDImax have a moderate hazard rating. Using these relative density thresholds, approximately 28 percent of the analysis area has a low bark beetle hazard rating, while 12 percent of the area has a moderate rating and the remaining 60 percent has a high hazard of beetle infestation.

Pathogens-Dwarf Mistletoe

Conklin and Fairweather (2010) indicate that stands with less than 20 percent of the ponderosa pine trees infected can be considered a light infection, stands with 20 to 80 percent can be considered moderately infected while stands with greater than 80 percent of trees infected with dwarf mistletoe are classified as severe. At moderate and severe infection levels there is evidence of decreased tree vigor, increased susceptibility to insect infestations, and stress-related (such as drought) mortality that accompany a changing climate. Currently 75 percent of acreage has a low dwarf mistletoe infection rating. Twenty two percent of acres have a moderate rating and 4 percent have a severe infection rating. Ninety-six percent of the project area meets the desired condition for mistletoe infection severity.

Assumptions and Methodology

Mechanical Treatment Approach

The majority of treatments will be conducted through the use of ground-based machinery (feller-bunchers, skidders, processors, loaders, and log trucks). This approach provides an efficient system for cutting and removing woody material from treatment locations. Ground-based operations are efficient and generally require a system of skid trails and roads to access areas within a stand.

Cable operations allow for harvesting on sites that are inoperable (steep, rocky terrain) for ground-based equipment. Additionally, they produce less soil disturbance than ground-based equipment and less noise disturbance than helicopter logging and allow for the removal of all material including branches and treetops. Costs for cable operations are higher than using ground-based equipment but lower than helicopter logging. The distance a cable logging system can operate is limited by the amount of cable stored on their drums, generally less than 2,000 feet. Cable operations requires a cleared corridor so logs can be brought to a designated roadside landing. Trees within corridors, including snags, must be removed to allow for operability and protect those working on the site. See the Silviculture Specialist report for more information about cable operations.

Data Rounding

Data is typically reported to the nearest acre, mile, or percentage. Most values have been rounded from their actual decimal values. Totals were calculated before any values were rounded in order to give the most accurate sum. Any apparent inconsistency between the total values reported in a table and a sum resulting from adding up individual values in a table typically accounts for a discrepancy of about 1 percent in the case of rounding percentages or miles, and less than 2 acres in the case of acres.

In an attempt to avoid confusion over these kinds of inconsistencies, minor adjustments to the numbers in the EIS document were made to allow for numbers in tables to add up correctly as displayed. As a result,

some numbers may not be exactly the same in the EIS document as compared to the silviculture specialist report. The numbers in this report are the most accurate and any differences do not alter any determination of effects.

Stand Data and Modeling

The basic unit for characterizing of vegetation conditions is the stand. All lands within the Apache-Sitgreaves, Coconino and Tonto National Forests are delineated into stands based on similar characteristics such as vegetation cover type, slope, aspect, species composition, aerial photo interpretation signatures, and management history. Stands vary in size depending upon their uniformity; within the Rim Country Project, this is from less than one acre up to 1,692 acres. Spatial and general vegetation information about each stand is stored in the stand database for each forest within the Forest Service Field Sampled Vegetation (FSVeg) database.

Stand exam data is an average characterization of the area within the stand boundaries. It is limited by sampling intensity and the variability within the sampled area. Comprehensive tree data has been collected on a subset of the stands within the analysis area over the last 25 years. Within each sampled stand, tree characteristics were measured at sample points, using both variable basal area factor plot and fixed plot designs. Specific tree data collected includes species, class, diameter, height, age, growth, damage and disease. Other data sometimes collected depending on design included surface fuels and plant association (USDA Forest Service 2013).

Modeling Assumptions

The following is a list of general modeling assumptions.

- All tree data was grown to the common year of 2019 and is considered to represent the existing condition.
- Beginning in the year 2019, using the Climate-forest vegetation simulator extension (N.L. Crookston 2014), the effects of climate change were incorporated in the data analysis using the Ensemble_rcp60 scenario.
- All tree cutting and removal was modeled in the year 2019.
- Two prescribed burns were modeled, post-mechanical treatment in the year 2024, and then again in 2034 with the exception of the aspen treatment which modeled one prescribed burn in the year 2024, post-mechanical treatment.
- After treatment, the tree growth data was simulated to the common year of 2029 and 2039 and is considered to represent the post treatment condition. 2029 conditions represent conditions 10 years after mechanical treatments and 2039 conditions represent conditions 20 years after mechanical treatments.
- The tree data does not indicate tree age. Simulations initially use diameter as a surrogate for age based on the vegetative structural stage definitions. We acknowledge that there are trees on the landscape where age class overlaps size class. For example, there may be young trees that are larger than 11.9 inches; or mid-aged trees that are larger than 18 inches; or mature trees that are less than 18 inches diameter at breast height.
- Within this project area, the majority of trees that meet the old tree definition are greater than or equal to 18 inches. On the ground cutting prescriptions would follow the Old Tree Implementation Plan (OTIP) and trees larger than 18 inches that do not meet the OTIP criteria may be cut during implementation.

- All cutting simulations assume 15 percent of the cut stems are left on site and 10 percent of the branchwood from the cut and removed stems are left on site. All other biomass resulting from the cutting is assumed to be removed.
- Snags and coarse wood amounts are based on the inventory or default parameters within the model if they were not inventoried. Snag fall rates and changes in surface fuels are based on default parameters.
- Default parameters within the model were used to predict tree growth, mortality, and dwarf mistletoe infection intensification.
- Dwarf mistletoe infections are nearly impossible to detect from remote imagery. Therefore, any nearest neighbor imputation process may impute stand data showing mistletoe infections to stands that are not infected and visa-versa.
- Forest vegetation simulator is a distance-independent growth model. It is not spatially explicit and cannot model tree groups and **tree pattern** together. The modeling results are an average approximation of the desired forested structure at the stand level and all results are interpreted as “attribute values” per acre. Output from the forest vegetation simulator model used in this analysis is a characterization of the existing condition and absolute conditions are neither intended nor implied.

Discussions on Stand Metrics

Measures of stand density used in this analysis are basal area, trees per acre and stand density index. Basal area is the cross-sectional area of all trees, measured in square feet per acre measured at 4.5 feet above the ground. Trees per acre is simply a count of the total number of trees on an acre. Stand Density Index is a measure of the relative stand density within forest stands.

Density

Stand density, a measure of the degree of crowding within stocked areas (Helms 1998), is the dominant factor affecting the health and vigor of conifer forests in the western United States (Waring and Schlesinger 1985) and high stand densities leads to reduced ecosystem resilience (Reynolds et al. 2013). One of the major factors affecting forest structure and development, specifically the rate at which individual trees grow and advance through successional stages, is inter-tree competition. Competition refers to density-related scarcity of one or more environmental factors necessary for growth (such as moisture, nutrients, and sunlight).

Trees per Acre

Trees per acre is simply a count of the number of stems per acre of an individual species or all species combined regardless of size. Trees per acre is much more informative when considered with an additional stand metric such as quadratic mean diameter or basal area. This additional information provides insight into the forest processes that may be occurring within a stand.

Basal Area

Basal area is the cross-sectional area of all stems of a species or all stems in a stand measured at breast height (4.5 feet above the ground) and expressed as square feet per acre. This analysis uses basal area as a key measure of density. Higher basal areas can be indicators of increased competition, risk to insect outbreaks, and density-dependent mortality as well as closed canopy conditions.

Stand Density Index

Stand Density Index (SDI) is a measure of relative stand density based on the number of trees per acre and the mean diameter (Reineke 1933). Percent SDIMax expresses the actual density in a stand relative to a theoretical maximum density possible for trees of that diameter and species. SDI is a good indicator of how site resources are being used by taking both tree size (diameter at breast height) and numbers (trees per acre) into account.

Those who use SDI, or any index of stand density, as an estimate of growing stock, must assume that the index is proportional to site utilization (Long and Smith 1984). Since the contribution of individual stand components to both total SDI and total site utilization is additive, SDI can be used to assess control of growing stock in uneven-aged stands as well as even-aged stands (Long and Smith, 1984). Although SDI and the maximum size-density relationship were originally described for pure, even-aged stands, Long and Daniel (1990) have proposed extension of its utility to uneven-aged and multi-aged situations.

Long (1985) divided SDI percentages into four zones which consider the percent of a stand occupied by trees. Based upon established forest density/vigor relationships, density-related mortality from competition begins to occur once the forest reaches 45 to 50 percent of maximum stand density (zone 3), and mortality is likely at density levels of 60 percent+ of maximum stand density (zone 4).

Openness and Interspace

Openness is defined by Reynolds et al. (2013) “as the inverse of canopy cover for a given area. For example, a forest with 70 percent canopy cover would have openness of 30 percent.” Determining openness at landscape scales is best accomplished thru aerial imagery analysis. At present, this sort of analysis is only available for a portion of the project area. In the absence of a detailed aerial imagery analysis we determined that stand-level inventory data was appropriate to classify the canopy conditions that currently exist within the project area. See the Implementation Plan (appendix D) for guidance in meeting these objectives.

A key characteristic of historical ponderosa pine and mixed conifer forests was the grass-forb-shrub interspersed among tree groups or interspace. Interspace is defined in this document as “Areas not currently under the vertical projection of the outermost perimeter of tree canopies (drip-line).” They are generally composed of grass-forb-shrub communities but could also be areas with scattered rock or exposed mineral soil. Interspaces do not include meadows, grasslands, rock outcroppings, and wetlands (exclusions adjacent to and sometimes within forested landscapes). As spaces between trees, tree groups and tree clumps, interspaces contribute to the “open canopy” character of frequent-fire forests. They often connect with other interspaces and thus are variably shaped and sized. Interspaces and tree group locations are dynamic and shift over time (Reynolds et al. 2013). While the terms openness and interspace are not to be used as treatment metrics, they may have application during the implementation of the proposed action. As a result, openness and interspace will not be used as a density metric for analysis but will appear in this EIS as well as Appendix D - Implementation Plan to assist during treatment implementation.

Issues/Indicators/Analysis Topics

Issue 3 – Large Tree Retention

This issue is addressed in the effects analysis for all alternatives. Large trees are addressed with treatment design and location, design features, mitigation measures, and BMPs to manage for desirable distributions of old trees and groups of large trees in all action alternatives. The Old Tree Implementation Plan and Large Tree Implementation Plan (OTIP/LTIP) (appendix D) were developed for the Rim Country to be

responsive to these issues while also being appropriate to the specific ecology and existing conditions in this project area.

Indicators/Measures:

- Number of acres of stands meeting criteria for SALT designation.

Environmental Consequences

In order to conduct a site-specific analysis, data from individual stands was used to calculate stand metrics. In order to scale these metrics up to a landscape level analysis, stand data was aggregated up to the 5th HUC watershed and then to the analysis area. The effects analysis period modeled is from 2019 to 2039.

Table 32. Desired and existing conditions for the project area

	Desired Condition	Existing Condition
Structure - Pattern	The majority of stands are in an open condition. Forest arrangement is in individual trees, small clumps, and groups of trees or randomly spaced trees interspersed within variably sized openings of grasses, forbs, and shrubs that are similar to historic patterns. Most forest stands in uneven-aged condition to meet forest resilience and sustainability goals while maintaining wildlife habitat.	The majority of stands are in a closed condition and lacking groups and clumps of trees or randomly spaced trees. Grasses, forbs and shrubs are underrepresented compared to historic patterns. This is departed from desired conditions consisting of a matrix of groups, clumps and individual randomly spaced trees with interspaces or openings.
Structure - Trees per acre	Trees are distributed across size classes with total number of trees per acre between 10 and 250. An idealized tree distribution across size classes totaling 74 trees per acre and carrying 90 square feet per acre of basal area would have 24, 18, 14, 10, and 8 trees in the 0-5", 5-12", 12-18", 18-24" and 24"+ size classes, respectively.	Total trees per acre is higher than the desired condition and are overrepresented in the smaller diameter classes and underrepresented in the larger classes. There are currently 718, 103, 32, 8, and 3 trees in the 0-5", 5-12", 12-18", 18-24" and 24"+ DBH size classes, respectively.
Basal Area	Generally, less than 90 square feet per acre to meet forest resilience goals, while maintaining wildlife habitat desired conditions. For MSO protected and nest/roost replacement habitat 110 to 120 square feet per acre is the minimum.	The current average basal area within the project area is 115 square feet per acre. High densities in terms of basal area make trees more susceptible to mortality from insects, disease, and competition and increase crown fire risk.
Stand Density Index	Maintain forest density between 25 percent and 45 percent of SDImax to maintain forest health and tree growth. For ponderosa pine this SDI range is between 112.5 and 202.5. For MSO protected and Nest/Roost replacement habitat in ponderosa pine desired forest density is between 45 percent and 60 percent of SDImax or between 202.5 and 270.	Currently 18 percent of stands meet the desired condition for SDI. High densities in terms of stand density index make trees more susceptible to mortality from insects, disease, and competition and increase crown fire risk.
Forest Insects	Stands in the project area are in the low or moderate hazard for bark beetles.	Currently 69 percent of acreage have a high bark beetle hazard rating. The remaining 31 percent of stands meet the desired condition for insect hazard.
Forest Disease	Stands in the project area have low to moderate dwarf mistletoe infection severity (Less than 20 percent of trees infected).	Currently 71 percent of acreage has a low dwarf mistletoe infection rating. 26 percent of acres have a moderate rating and 4 percent have a severe infection rating. 96 percent of the project area meets the desired condition for mistletoe infection severity.

Alternative 1 – No Action

Direct and Indirect Effects

Under alternative 1, no acres would receive either prescribed cutting or prescribed fire treatment. Although this alternative does appear to meet some of the desired conditions identified in the land management plans concerning forest structure, it would not move the forest forward in initiating the re-establishment of a fire-dependent, resilient, diverse, and sustainable forest ecosystem. For example, based on a broad array of research, current stand conditions would continue to develop so that the overabundance of trees in the smaller size classes (0-5 and 5-12 inch size classes) at the landscape scale, but they would likely develop at a slower rate due to increased competition and water stress. At the same time, the slow transition of intermediate and mature forests would lead to an increasing lack of young, developing forests. In the likely case of one or more large disturbance events (such as wildfire, drought, insects), the result would be an over-abundance of young forests. For a more thorough analysis of the effects of large disturbance such as uncharacteristically large or severe wildfires, consult the Fire Ecology Specialist report (USDA FS 2022).

Without treatment, stands in the analysis area would be much less resilient to disturbances such as multi-year drought, insects and disease such as bark beetle and mistletoe, and wildfire (Abella 2007). Increased drought stress and insect attacks are often associated with increased tree density, altered tree spatial arrangement, and shifted forest composition that have resulted from fire exclusion, grazing, and past logging. These changes in forest structure may exacerbate tree mortality due to increased competition among trees (Kane et al. 2014, p. 171). At the fine scale, these disturbances would likely result in a greater mortality rate for areas with dense forest, which include groups and clumps of large trees (Zhang et al. 2013).

While the intent of 4FRI is to restore composition, structure and pattern at the landscape scale, individual treatments are applied at the stand scale. It is important to understand how these individual stand treatments scale up to larger scale changes across the landscape. As treatments are applied to individual stands during implementation, these individual stands effects will scale up to the watershed scale and eventually to the landscape scale over time. Figure 30 and figure 31 demonstrate how these changes at smaller scales sum up to a considerable change at larger scales. Though this change is shown in figure 30 and figure 31 for structural characteristics such as trees per acre and basal area the effect would be similar for other landscape attributes across resources. Additionally, as the treatments in Rim Country were designed to be ecologically responsive (higher post-treatment densities on more productive sites), and assigned using a condition-based management approach, the spatial distribution of post-treatment stand densities would mimic historic distribution far more than the existing condition.

Composition

Forest composition is not expected to change dramatically under this alternative if there are no large-scale disturbances such as wildfire or epidemic-level insect outbreaks. Ponderosa pine would still be the dominant cover type within the analysis area. Mixed conifer would make up a moderate proportion of the analysis area, though the composition of shade tolerant species such as white fir may increase considerably in this forest type. Juniper, grasslands, and other hardwoods would continue to make up a minor part of the analysis area. Without wildfire or other types of disturbance, aspen would continue to decline, as normal succession pressures continue to favor conifer establishment. This continued encroachment may result in the loss of aspen from parts or all of the analysis area. Climatic models for the southwestern U.S. predict continued warming, greater variability in precipitation, and increased severity and longevity of drought. These climatic changes would likely contribute to continued and

perhaps increasing tree mortality, which may lead to large shifts and contractions in the range of dominant trees throughout much of the region (Kane et al. 2014).

In general, overstory density would increase and understory species richness would decline significantly (Korb and Springer 2003). Without treatment, understory grass vigor would be expected to be reduced. Less sunlight would reach the forest floor. As a result, understory diversity would decrease, which would reduce the overall biodiversity found in frequent-fire forests.

Structure

Uneven-aged Structure

Uneven-aged forest structure is the desired condition. Under this alternative, there is little change to forest structure (figure 21). Some trees will grow into larger size classes, but the overall the portion of stands that can be considered uneven-aged remains relatively unchanged. The uncharacteristically high number of trees in the smaller and medium size classes provide excessive competition with larger trees in the stand, slowing growth and limiting diameter growth of the largest trees in the stand. The no action alternative provides little improvement over the Existing Condition into the future.

While this indicator meets the desired conditions for some uneven-aged structure in the land management plans, this does not account for the possibility of an uncharacteristic wildfire or other substantial disturbance event, such as a beetle outbreak or long-term drought. There is an abundance of small diameter trees across the analysis area, far above historic conditions. Because of the current structure, including overstocked forests and ladder fuels created when smaller trees grow directly beneath the canopy of larger trees, the current landscape would be less resilient if a catastrophic event were to occur. Many, if not most, of the trees would be killed, resulting in large areas lacking live trees. Natural regeneration or reforestation planting would create large even-aged, young forests, with little structural diversity for the foreseeable future.

Density

Measure of density in this analysis include trees per acre, basal area and stand density index. The overall tree density continues to remain very high under this alternative, averaging nearly 1,000 trees per acre through much of the area (See table 28 in the silviculture specialist report). All 5th HUC watersheds currently do not meet the desired condition for trees per acre. In general trees are overrepresented in the smaller size classes and underrepresented in the larger size classes. Smaller trees and their aggregated spatial pattern on the landscape has resulted in dense thickets of “dog-haired” pine. While there would be some density-related mortality in the smaller trees as time goes by, this trend of “dog-haired” thickets of pine are expected to continue into the foreseeable future under this alternative. Across the analysis area, forested stands would continue to be dominated by small diameter trees into the future. This tree density would result in reduced tree growth and increased mortality, especially in older trees, stagnated nutrient cycles, decreased herbaceous and shrub forage quality and quantity (Covington and Moore 1994a). Without cutting or fire disturbances, tree regeneration would be inhibited and the trend would be a shift to the larger size classes maintaining extremely dense conditions that are not resilient to disturbances such as fire, insects, and climate.

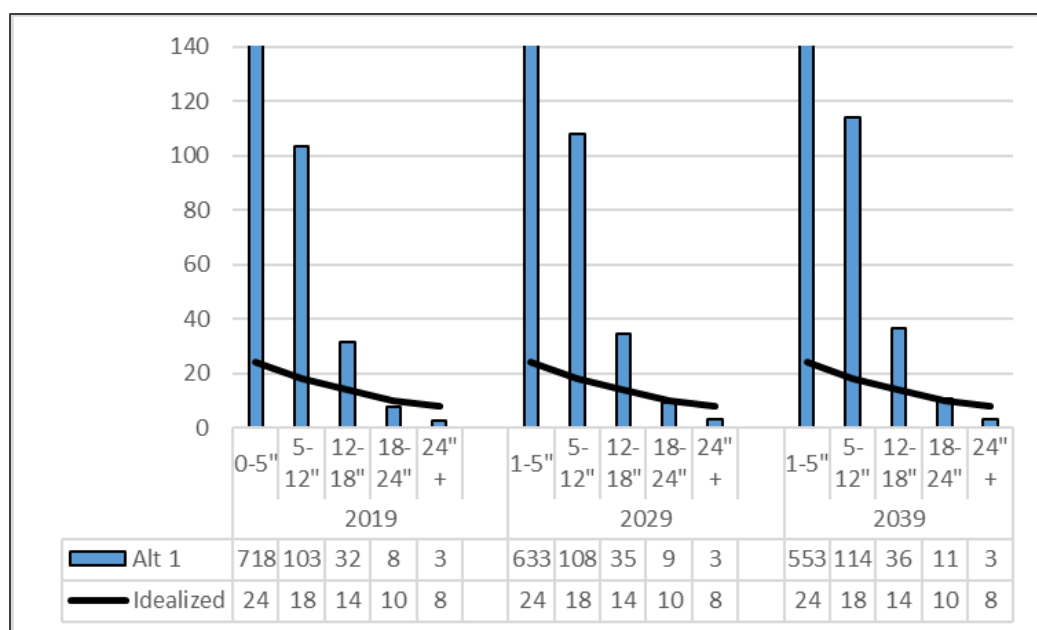


Figure 21. Alternative 1 – no action – distribution of trees per acre across size classes across the analysis area as well as an idealized distribution of trees per acre

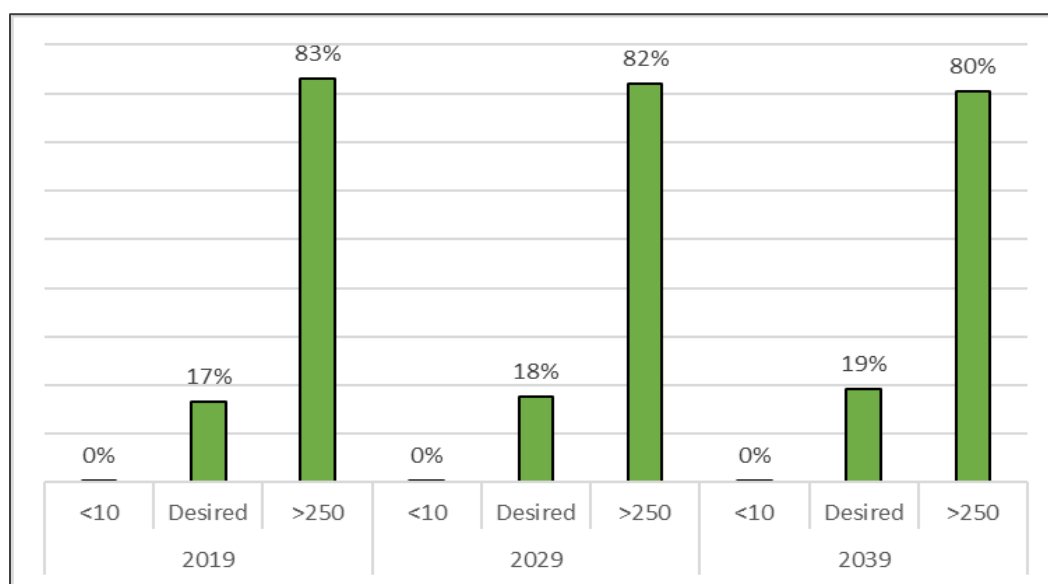


Figure 22. Alternative 1 – no action – percent of acres meeting desired condition for trees per acre across the analysis area

Under the no action alternative, basal areas across the analysis area would average 115 square feet per acre, ranging from 60 square feet per acre in the Carrizo Creek watershed, which has experienced a considerable amount of uncharacteristic severity wildfire, to 166 square feet per acre in the Salome watershed, and Haigler Creek-Tonto Creek watershed, dominated by dense ponderosa pine evergreen oak cover type. This excessive stocking is expected to increase to, on average, to 137 square feet per acre by 2039. Currently, only 25 percent of acreage meets the desired condition for basal area (figure 23). The percentage of stands that meet the desired condition would be reduced to 19 percent by 2039 under the no action alternative (figure 23).

Continuous tree growth would allow for forest stand densities to depart further from the desired condition. This would result in increasing competition for limited resources (water, light, growing space, and soil nutrients). Competition-induced mortality and growth stagnation would continue to increase, along with susceptibility to potential insect and disease outbreaks. The current conditions and effects of no action over the next thirty years support a shift away from frequent, low severity surface fires to increasingly larger high-severity crown fires (Cooper 1960, Swetnam 1990, Covington and Moore 1994a, Kolb et al. 1994, Swetnam and Baisan 1996). For more information, consult the Fire Ecology Specialist Report (USDA Forest Service 2019). These conditions would not meet the purpose and need for fire-dependent, resilient, diverse, and sustainable forest ecosystems.

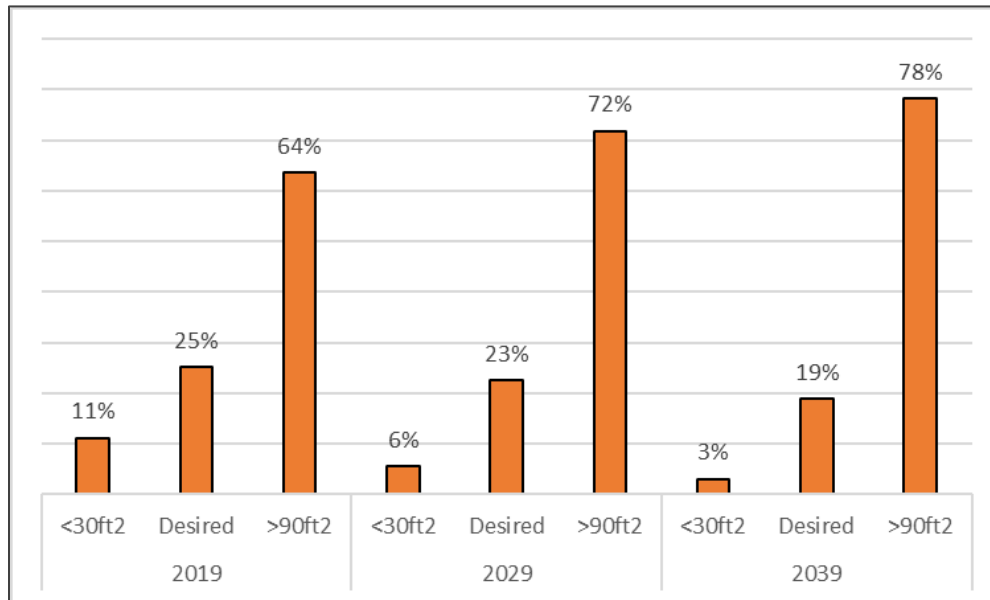


Figure 23. Alternative 1 - no action – percent of acres meeting desired condition for basal area across the analysis area

Stand Density Index (SDI) is a measure of relative stand density based on the number of trees per acre and the mean diameter (Long 1985). Percent SDImax expresses the actual density in a stand relative to a theoretical maximum density possible for trees of that diameter and species (SDImax is 450 for this analysis). SDI is a good indicator of how site resources are being used by taking both average tree size and trees per acre into account. SDImax represents an empirically-based estimate of the maximum combination of quadratic mean diameter and density which can exist for any stand of a particular forest type.

Currently across the analysis area, SDI averages 263 or 58 percent of SDImax and is considered in the zone where density related mortality is prominent and approaching the zone where imminent mortality would occur. Values range from 140 in the Carrizo Creek watershed, which has experienced a considerable amount of uncharacteristically severe wildfire to 387 in the Upper North Fork White River watershed which has a substantial amount of the ponderosa pine evergreen oak cover type. Overall, SDI and its relation to SDImax continues to increase to 296 or 66 percent of SDImax by 2039. In relation the desired condition, currently 18 percent of acres within the analysis area meet desired condition for SDI. This number would decrease to 14 percent by 2039.

Over time, with no action, continuous tree growth will allow forest stand densities to remain high and extremely high on the majority of acres (Das et al. 2011). This would result in increased susceptibility to

insect epidemics, particularly bark beetles and intense individual tree competition and competition-induced mortality, decreased individual tree diameter growth and stand volume, and forage production over time and further departure from the desired condition.

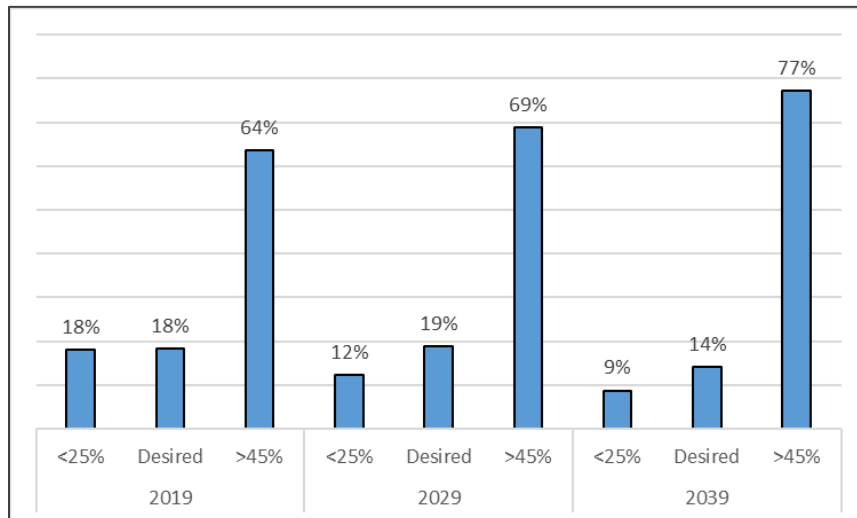


Figure 24. Alternative 1 - no action – percent of stands meeting the desired condition for stand density index

Large Tree and Old Tree Structure

Stands of post settlement trees where the basal area of trees greater than 18" is more than 40 feet of basal area can be considered stands with an abundance of large trees (SALT stands). These stands occur outside of Mexican spotted owl protected activity centers, Mexican spotted owl Recovery habitat and wildland urban interface and are being identified for their distinctive forest structure.

Under this alternative, no trees would be removed through cutting. Therefore, all large and old trees are expected to remain, except they are likely to be more susceptible to mortality from drought, pests, and disease as well as wildfire (Das et al. 2011, Ritchie et al. 2008). Across all 5th HUC watersheds in the analysis area the number of acres meeting SALT criteria is currently estimated to be 44,742 acres. This number would increase to 87,098 acres by 2039. This is the result of current trees continuing to increase in diameter growth and does not take into account the potential mortality from drought, insects, disease and wildfire.

This alternative would also result in higher risk of mortality, especially for larger trees, because of an increasing risk of infection from pests or disease (Fischer et al. 2010), high-severity or uncharacteristic wildfire (Coop et al. 2016) (Fiedler et al. 2010), or increased drought stress from competition (Erickson and Waring, 2014). A number of studies have found that higher forest density leaves large and old trees more susceptible to mortality. Erickson and Waring (2014) concluded that, "treatments removing small, neighboring trees may be critical in maintaining old ponderosa in the landscape, particularly under future climate change and increasing drought frequency in the western USA." Modifying forest conditions to facilitate low severity fire on the landscape has been identified as a key condition to preventing increased mortality of large and old trees over the next several decades (Fiedler et al. 2007, Kolb et al. 2007, Ritchie et al. 2008). Thus, while this alternative may increase the amount of large and old trees based on model results, these results do not account for the likely substantial loss of old and large trees as a result of various forest disturbances (such as uncharacteristically severe wildfire), which would decrease the amount of old and large trees in the analysis area.

Under this alternative it is possible that one or more naturally caused wildfires would be managed to benefit forest resources. Depending on the ability to manage one or more naturally caused fires based on values at risk, fuel, and weather conditions under this alternative some wildfires could result in small openings that decrease areas of intermediate aged trees, which would then contribute to establishment of a new young cohort of trees. Management of naturally caused fires under this alternative may also have the effect of reducing basal area and SDI by killing small trees or groups of small and/or intermediate aged trees. These fires could also result in mortality of some large and old trees or large patches of high-severity mortality. Based on those areas in recent wildfires that have been managed for resource benefits, this effect may be very limited across the landscape. The current condition of the Forest would limit the ability to manage naturally-occurring wildfires in the analysis area at low to moderate-intensity levels without potential unacceptable effects on values at risk.

Forest Process

Insects

Under the no action alternative, the proportion of acreage with a high hazard rating for bark beetles would increase from 69 percent to 81 percent, a considerable majority of the landscape. The proportion of acreage with a low or moderate hazard rating would decrease. Some large watersheds such as Fossil Creek-Verde River, Gun Creek-Tonto Creek and Lower Chevelon watersheds are currently over 90 percent high hazard for bark beetles. The existing condition is departed from the desired condition and would further depart between the existing condition and 2039 as basal area and SDI continue to increase beyond the desired condition.

Drought, coupled with high tree densities, can lower resistance to beetle attacks. Bark beetle population dynamics suggest that homogenous, dense, even-aged stands are highly susceptible to beetle outbreaks. Susceptibility to western pine beetle would slowly increase over time. Areas with the greatest likelihood of infestation are those stands with densities greater than 120 square feet of basal area and average stand diameters greater than 12 inches diameter at breast height. Susceptibility to ips beetles would continue to increase with activity most likely occurring in response to a drought or a snow or ice event that creates fresh pine debris.

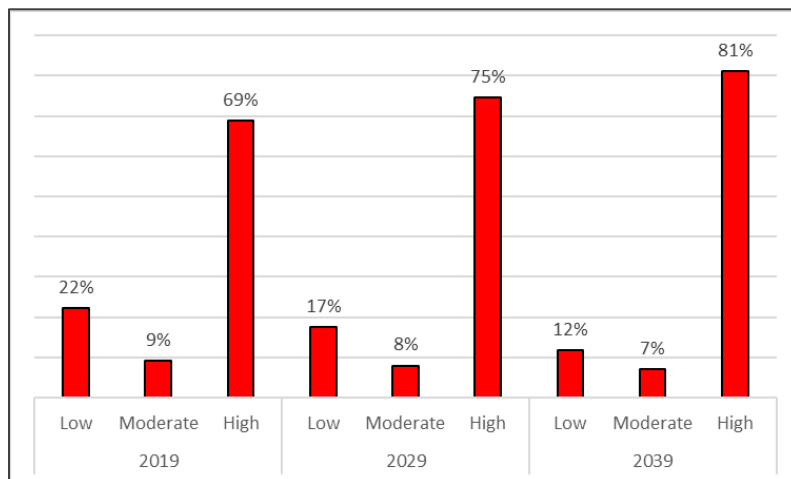


Figure 25. Alternative 1 - no action – distribution of bark beetle hazard rating classes across the analysis area

Disease

Across the analysis area, approximately 71 percent of the area is not infected or has a low infection level, 26 percent has a moderate severity rating and 4 percent has a high severity rating. This distribution shifts to higher severity ratings over time. By 2039, 30 percent of acres are classified as moderate and 10 percent of acres are classified as severe. This is an indication that mistletoe infection is intensifying and spreading over time. Dwarf mistletoe infections would not be reduced and may intensify in infected trees and the surrounding trees, reducing the growth, vigor, and longevity of ponderosa pine (Conklin 2000). Though most of the analysis area meets the desired condition of having a low or no dwarf mistletoe severity, 40 percent of the analysis area would have a moderate or severe dwarf mistletoe severity rating by 2039 and would not meet the desired condition. Stands would further depart from the desired condition over time as infected stands intensify their infections and infect adjacent areas (Conklin and Fairweather 2010).

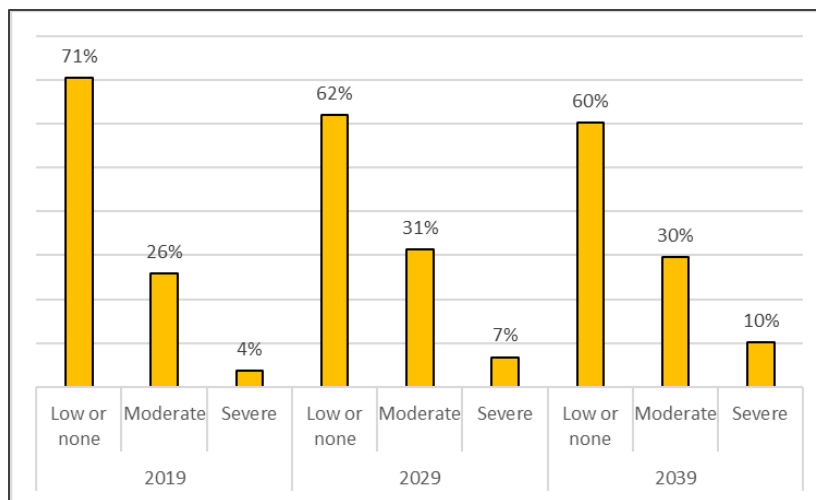


Figure 26. Alternative 1 - no action – dwarf mistletoe severity rating classes across the analysis area

Fire Adaptation

For a more thorough discussion of this alternative in terms of fire adaptation, consult the fire ecology specialist report (USDA Forest Service 2019). In general, this alternative does not support the purpose and need to develop or return to a forest ecosystem that is fire-dependent, resilient, diverse, and sustainable. This alternative would continue to support the current shift away from frequent, low severity surface fires to conditions that are more likely to support increasingly larger high-severity crown fires (Cooper 1960) (Swetnam 1990) (Covington and Moore, 1994a) (Kolb et al 1994) (Swetnam and Baisan, 1996). The current forest structure is quite different from conditions from the natural range of variation of the native microbes, plants, and animals living in western ponderosa pine and dry mixed conifer forests (Covington and Moore 1994a, Reynolds et al 2013). As a result, this project area would remain susceptible to undesirable fire behavior and effect, and other disturbance agents, such as bark beetles and disease, over time.

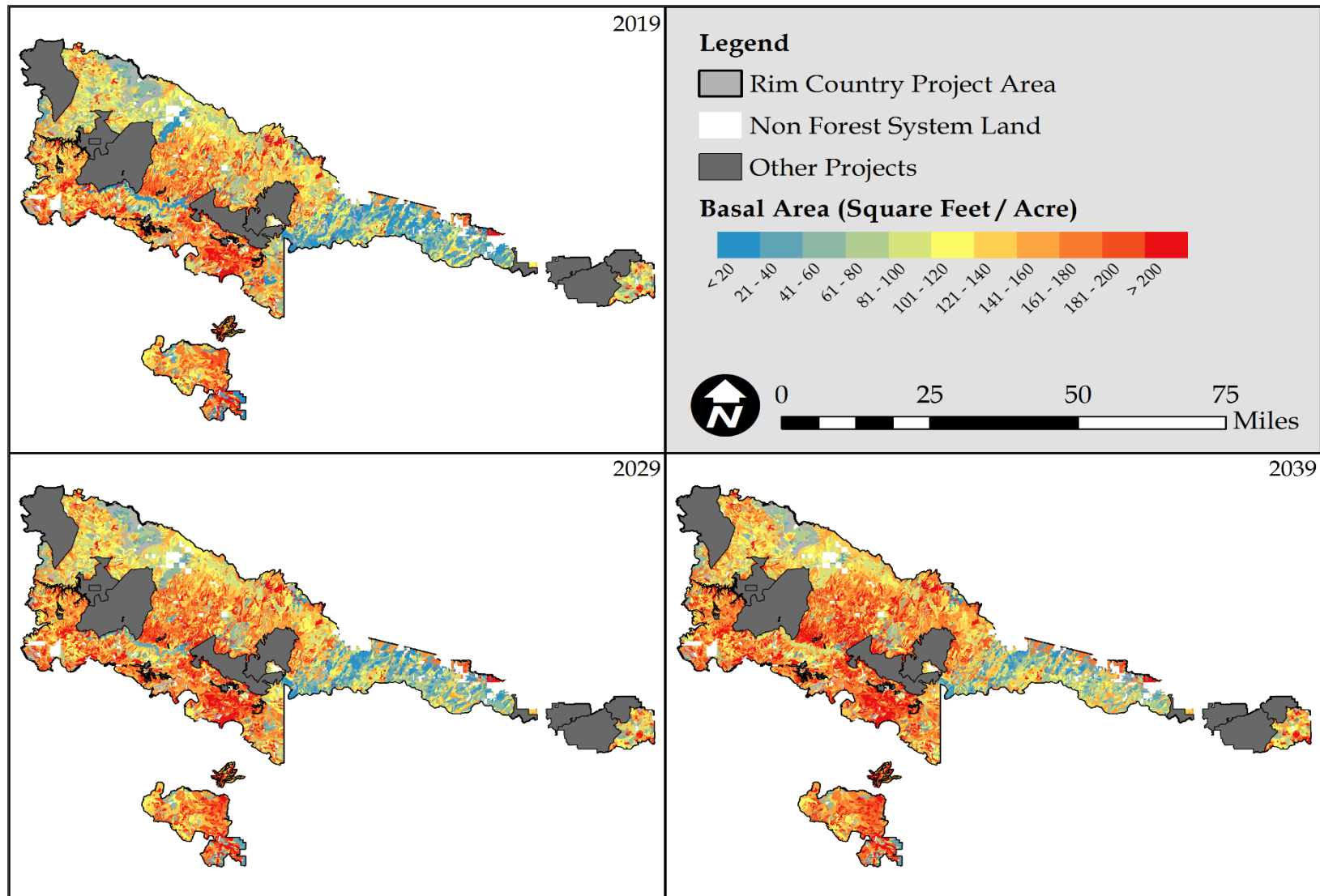


Figure 27. Alternative 1 – no action – basal area

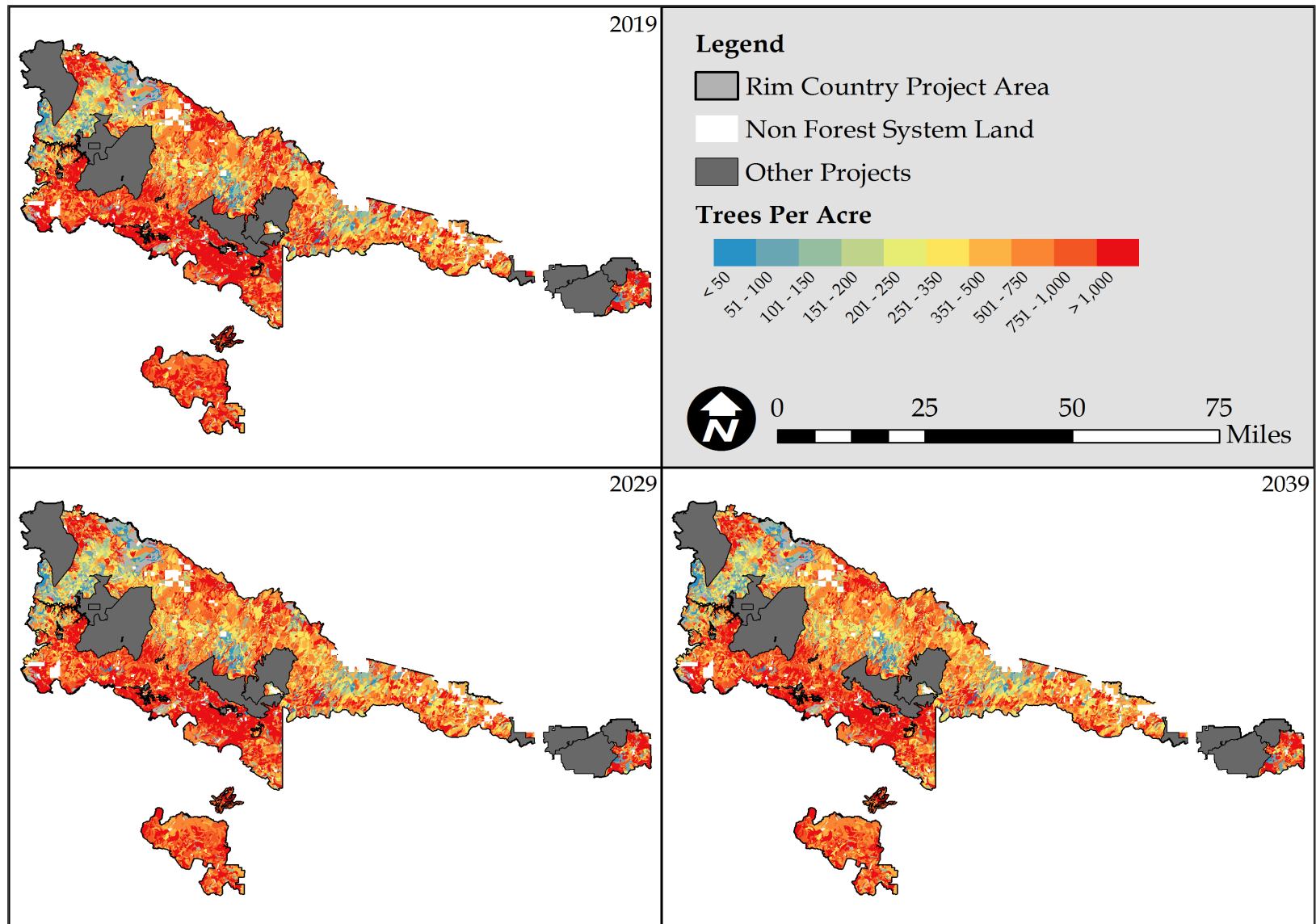


Figure 28. Alternative 1 – no action – trees per acre

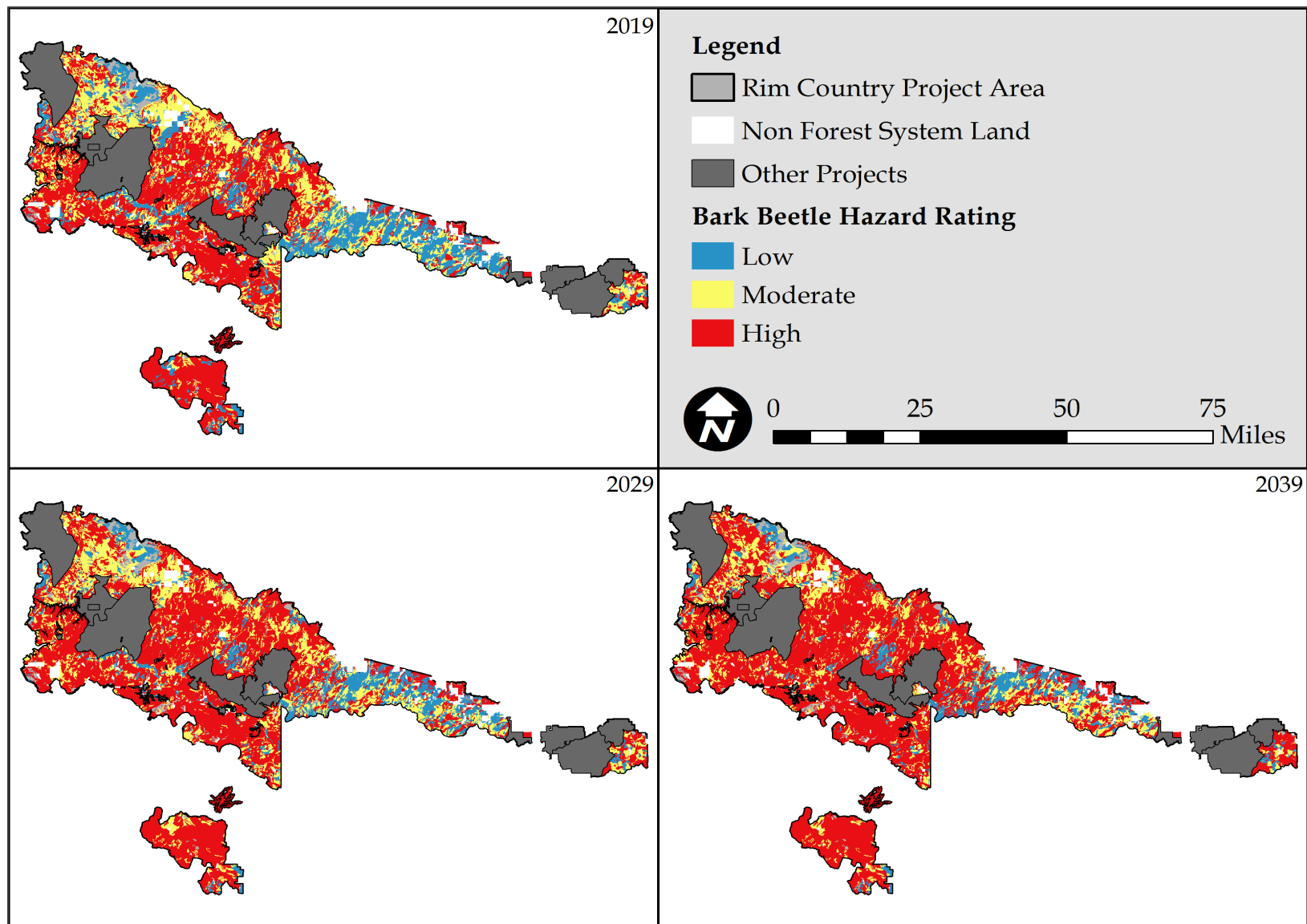


Figure 29. Alternative 1 – no action - bark beetle hazard rating

Effects Common to Both Action Alternatives

(The Effects Common to Both Action Alternatives section has been added from the Silviculture Specialist Report for consistency)

Climate Change

Risks associated with dense forest conditions would be reduced and resilience to the impacts of large scale disturbance under drier and warmer conditions would be improved by implementing the treatments proposed under alternatives 2 and 3. Prior treatments will benefit the forest by reducing densities and reducing stresses associated with completion. Treated forest will be more resilient to climate change than untreated forest (Kerhoulas et al 2013). Within-forest carbon stocks would be reduced under alternatives 2 and 3, however large scale stand replacing wildfires such as the Rodeo-Chediski and Wallow fires that emit enormous amounts of carbon dioxide would be less likely to occur. Individual tree growth would improve, resulting in larger average trees size and increased carbon storage over time offsetting short term losses of carbon removed through the mechanical thinning. Some of the carbon biomass removed by mechanical thinning would be sequestered for a considerable period of time in the form of forest products.

Residual Tree Damage

Some damage to residual trees would be expected in Alternatives 2 and 3 with the felling, tractor yarding and piling operations associated with mechanical treatments in ponderosa pine. Damage rates should be similar or less than current silviculture practices due to the more open conditions created. The Proposed Action would result in the most potential damage because of the extensive harvesting in overly dense stands. Damage would be minimized through contract administration, on-site inspections, and proper harvest methods. All piling and/or low-severity burning treatments would reduce understory stocking and reduce inter-tree competition as well as stimulate understory vegetation (shrubs, forbs, grasses). Prescribed fire is expected to damage some residual trees and increases short-term risks to low level bark beetle activity.

In-woods Processing and Storage Sites

Sites were proposed based on terrain, road access, utilities, and potential impacts to resources. On these sites, most existing trees other than those that meet the large and old tree implementation plan would be removed. There will be a short-term loss of productivity of forest resources such as tree volume, and forage, for about 20 years until wood processing operations are ended and sites are reclaimed and returned to timber production via natural and artificial reforestation. The processing sites have populations of merchantable timber and fuelwood species, but with the small acreage affected and with design features in place; effects to forest product resources would be temporary until revegetation occurs on the compacted soil.

Rock Pits

There would be a short-term loss of productivity of forest resources such as tree volume, and forage, until the sites are reclaimed and returned to timber production via natural and artificial reforestation. The expansion areas have populations of merchantable timber and fuelwood species, but with the small acreage affected and with design features in place; effects to forest product resources would be temporary until revegetation occurs on the compacted soil.

Alternative 2 – Modified Proposed Action

Direct and Indirect Effects

Under alternative 2, prescribed cutting using ground-based or cable operations and/or prescribed fire treatment would be applied in order to move toward or meet the desired conditions. This alternative meets or moves the project area toward the desired conditions identified in the land management plans and moves the project area forward in initiating the re-establishment of a fire-dependent, resilient, diverse, and sustainable forest ecosystem. The distribution of trees across size classes would be more representative of a historic size class distribution as many trees in the smaller size classes would be removed or burned. At a landscape scale forest composition, structure, pattern, and process would all be improved.

While the intent of 4FRI is to restore composition, structure and pattern at the landscape scale, individual treatments are applied at the stand scale. It is important to understand how these individual stand treatments scale up to larger scale changes across the landscape. As treatments are applied to individual stands during implementation, these individual stands effects will scale up to the watershed scale and eventually to the landscape scale over time. Figure 36 to figure 37 demonstrate how these changes at smaller scales sum up to a considerable change at larger scales. Though this change is shown in figure 36 to figure 37 for structural characteristics such as trees per acre and basal area the effect would be similar for other landscape attributes across resources. Additionally, as the treatments in Rim Country were designed to be ecologically responsive (higher post-treatment densities on more productive sites), and assigned using a condition-based management approach, the spatial distribution of post-treatment stand densities would mimic historic distribution far more than the existing condition.

Composition

Forest composition would improve under this alternative. Ponderosa pine would still be the dominant forest cover type. Mixed conifer would continue to make up a moderate proportion of the analysis area. As a result of prescribed cutting using ground-based or cable operations and prescribed fire, prevalence of later seral species such as white fir and corkbark fir in forested stands would be reduced and would better represent their role in the natural range of variation. Pinyon juniper woodlands and oak species would continue to make up a considerable part of the analysis area as treatments in woodlands are not designed to affect composition. The treatment of conifer encroached grasslands would expand their range to more fully represent the Desired Condition to reestablish their historical extent. The protection and improvement of aspen stands would promote regeneration and reduce inter-tree competition and improve their condition under this alternative; however, aspen is one of the species predicted to be most affected by a changing climate. The condition of less common but important species such as maple and Emory oak would be improved through the cutting of other species such as juniper and other species.

This analysis has considered the effects of a changing climate. Though this alternative would result in a landscape more resilient to climate change, climatic models for the southwestern U.S. predict continued warming, greater variability in precipitation, and increased drought (Kane et al. 2014, Triepke et al. 2019). These climatic changes would likely contribute to some level of tree mortality; however, considerably less than the no action alternative. A changing climate may lead to large shifts and contractions in the range of dominant trees throughout much of the region (Kane et al. 2014).

Structure

Uneven-aged Structure

Uneven-aged forest are defined as forests composed of three or more distinct age classes of trees, either intimately mixed or in small groups. The Desired Condition is for uneven-aged forest structure to occur on a majority of acres. Under this alternative, there is considerable change to forest structure (figure 3-12). Across the project, even-aged structure would dominate the landscape with a balance of trees in smaller, medium and larger size classes. The proportion of stands with uneven-aged structure would increase into the future. This alternative would meet the Desired Condition for uneven-aged structure in the land management plans and forest structure would more closely resemble the natural range of variation. Modeling indicates that some stands would move toward more even-aged conditions in the dominant cover types proposed for treatment as a result of removal of trees from the smaller size classes and retention of trees in the larger size classes. Modeling the most intense extent of the range of the prescribed treatment, combined with the protection of large and old trees, produced even-aged stands of larger trees in some cases. However, as treatments are applied on the ground, the use of the large and old tree implementation plans, in accordance with an uneven-aged thinning strategy, would be able to produce uneven-aged conditions across much of the landscape. Individual tree growth would increase and trees would move into larger size classes as a result of a reduction in individual tree competition. Naturally-occurring regeneration would provide additional vertical structure over time.

An additional, and potentially more substantial, benefit to forest structure would be a reduction in the possibility of an uncharacteristic wildfire or other substantial disturbance event, such as a beetle outbreak or long-term drought. Under this alternative, stands would be more resistant to uncharacteristic fire and insect outbreaks and more resilient to drought. The balance of size classes and uneven-aged structure would provide conditions favorable to restoration of a natural fire regime.

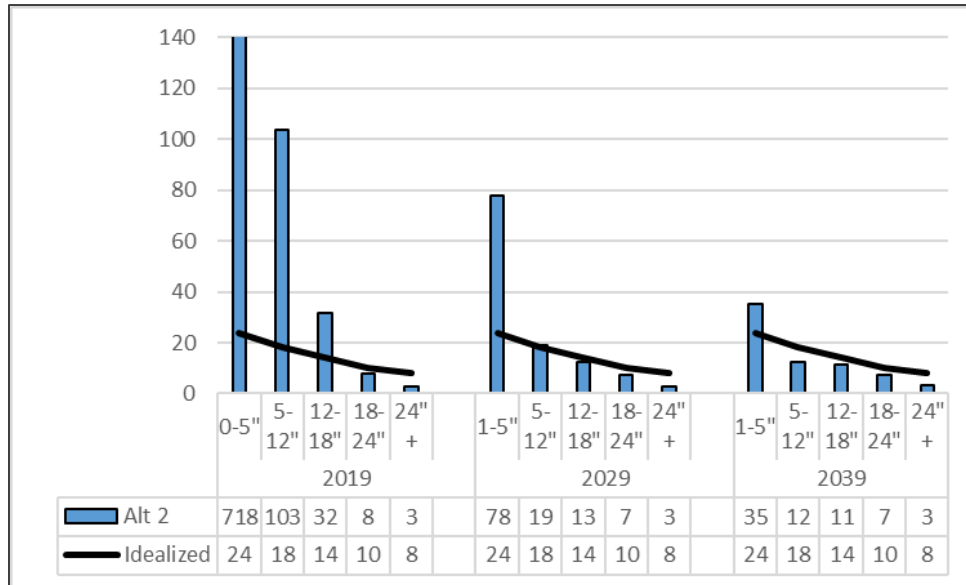


Figure 30. Alternative 2 – modified proposed action – distribution of trees per acres across size classes across the analysis area

Density

Measure of density in this analysis include trees per acre, basal area and stand density index. With prescribed thinning and fire, there would be considerable change to the size class distribution in the near future. Alternative 2 would effectively meet the desired condition for trees per acre with a balance across

size classes. The overall tree density would decrease considerably under this alternative, from 863 in the existing condition to 119 in 2029 and 69 by 2039.

While the initial reduction in trees per acre would result from a combination of mechanical and prescribed fire activities, the reduction after 2029 can be attributed to the recurring prescribed fires over time. Prescribed fires with higher or lower severity (such as, burning under hotter or cooler and/or wetter conditions) from 2029 to 2039 could be implemented to maintain a higher or lower number of trees per acre in the smaller size classes if desired. The reduction in tree density would increase individual tree growth and reduce density dependent tree mortality. Understory grasses, forbs herbs and shrubs would increase in quantity (Covington and Moore 1994a).

The desired condition is to retain a basal area of between 30 to 90 square feet per acre across most habitat types outside of Mexican spotted owl protected activity centers. While the Land Management Plans provide a desired condition with a range of basal areas ranging from 20 to 180 square feet per acre depending on cover type, for this analysis, at the project level, for ease of comparison of effects between alternatives, 90 square feet per acre is the breakpoint for the resource measure across the analysis area. For both mixed conifer and ponderosa pine cover types it is desired to maintain basal area at less than 90 square feet per acre though exceptions exist to provide heterogeneity across the landscape as well as specific wildlife needs for dense and closed canopy forest conditions. For a more thorough analysis of the effects of this alternative within Mexican spotted owl and northern goshawk habitat, consult the Wildlife Specialist Report (USDA Forest Service 2022).

Under Alternative 2, basal areas across the analysis area would average 53 square feet in 2029 and 53 square feet in 2039. While currently only 17 percent of stands meet the desired condition, by the year 2029, 91 percent of stands would have met the desired condition, and by 2039, over 93 percent of stands would meet the desired condition. This would result in decreased inter-tree competition for resources such as water, light, growing space, and nutrients. Individual tree growth would increase and density dependent mortality would be dramatically reduced along with susceptibility to potential insect and disease outbreaks. These conditions would indicate a shift from the current larger and higher severity crown fires that the forest would currently experience to cooler, higher frequency, lower severity surface fires (Cooper 1960) (Swetnam 1990) (Covington & Moore, 1994a) (Kolb et al 1994) (Swetnam and Baisan 1996) that persisted prior to European settlement. The reductions in basal area would meet the desired condition and purpose and need for fire-dependent, resilient, diverse, and sustainable forest ecosystems at the landscape and watershed scales.

While all watersheds would have their average basal areas reduced to within the desired condition, some watersheds such as Gun Creek-Tonto Creek and Rye Creek-Tonto Creek would experience considerable additional mortality as a result of prescribed fire between 2029 and 2039. Prescribed fires with lower severity effects (such as, burning under cooler and/or wetter conditions) in 2029-2039 could be implemented to maintain the desired basal area and continue to meet the desired condition. Currently only 25 percent of stands are meeting the desired condition for basal area. As a result of alternative 2, 67 percent of stands would meet the desired condition in 2029 and 66 percent in 2039.

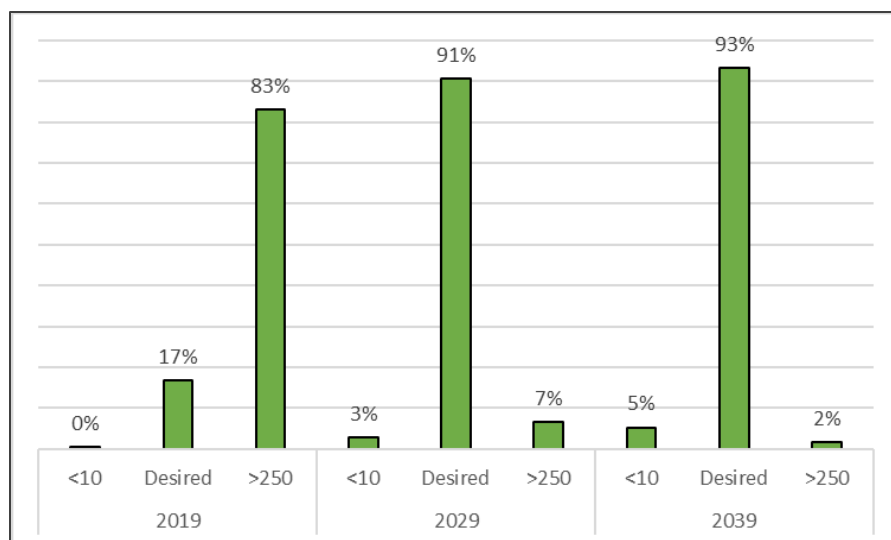


Figure 31. Alternative 2 – modified proposed action – percent of acres meeting desired condition for trees per acre across the analysis area

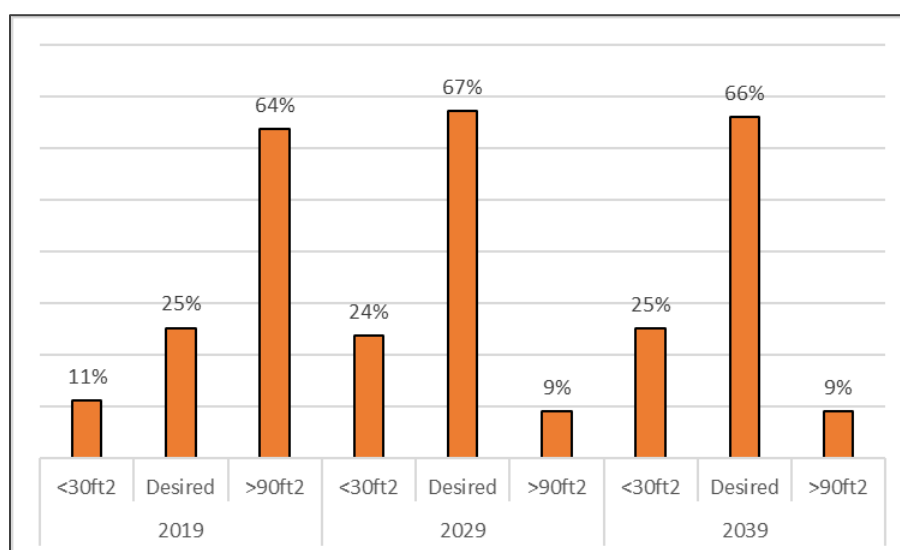


Figure 32. Alternative 2 – modified proposed action – percent of acres meeting desired condition for basal area across the analysis area

Stand Density Index (SDI) is a measure of relative stand density based on the number of trees per acre and the mean diameter (Reineke 1933, Long 1995). Percent SDI_{max} expresses the actual density in a stand relative to a theoretical maximum density possible for trees of that diameter and species. SDI is a good indicator of how site resources are being used by taking both average tree size and trees per acre into account. SDI_{max} represents an empirically-based estimate of the maximum combination of quadratic mean diameter and density which can exist for any stand of a particular forest type.

The desired condition for SDI is to be between 25 and 45 percent of SDI_{Max} or between 112.5 and 202.5. Currently, across the analysis area, SDI averages 263 or 58 percent of SDI_{Max} and is considered extremely high. As a result of the proposed action, SDI would be reduced to 96 or 21 percent of SDI_{Max} by 2029 and 86 or 19 percent of SDI_{Max} by 2039. While the proportion of acres meeting desired

condition currently is 18 percent, the proportion meeting the desired condition would increase to 28 percent in 2029 and to 20 percent by 2039.

It should be noted that the treatments were modeled to represent the most intense end of the range of proposed treatments in order to ensure that post-treatment densities are within the effects analyzed. During implementation, the implementation plan directs treatments to represent the entire range of treatment intensities and will result in considerably more acres meeting the desired condition. Additionally, prescribed fires with lower severity effects (such as burning under cooler and/or wetter conditions) from 2029 to 2039 could be implemented to maintain a higher SDI if desired. SDI values between 25 percent and 45 percent of SDIMax are associated with high understory production and intermediate levels of individual tree diameter growth as overall stand growth is concentrated on fewer number of trees than in more dense forests. Depending on the level of tree aggregation, little inter-tree competition would be occurring. Competition could still be occurring within dense tree groups.

Over time, with the proposed action, stand densities should stabilize as the reintroduction of fire returns natural disturbance processes to the landscape. This would result in reduced susceptibility to insect epidemics, particularly bark beetles, as well as reduced density dependent mortality, increased individual tree diameter growth and forage production over time, and continued attainment of the desired condition.

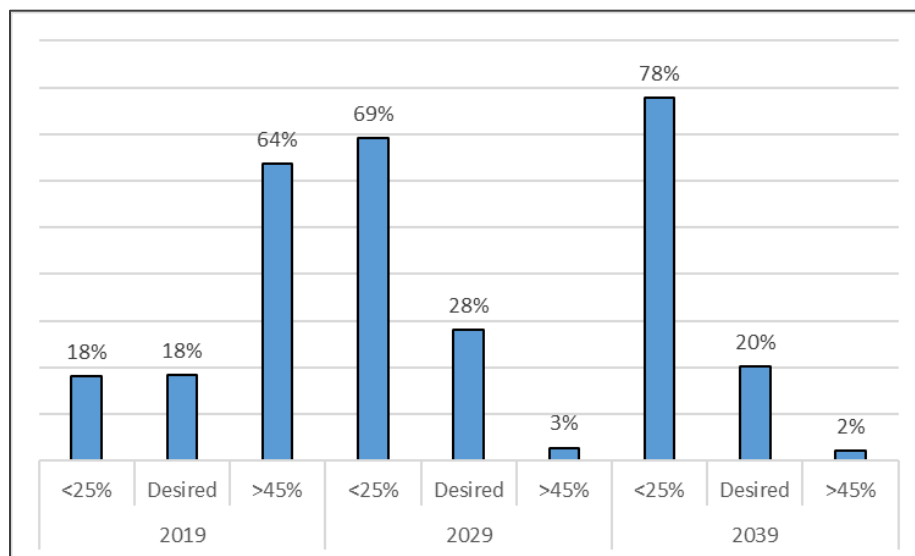


Figure 33. Alternative 2 – modified proposed action – percent of stands meeting the desired condition for stand density index

Large Tree and Old Tree Structure

Ponderosa pine stands of post settlement trees where the basal area of ponderosa pine trees greater than 18 inches diameter at breast height is more than 40 square feet per acre can be considered stands with An abundance of large trees (SALT stands). These stands occur outside of Mexican spotted owl protected activity centers, Mexican spotted owl Recovery habitat and wildland urban interface and are being identified for their distinctive forest structure.

Across all 5th HUC watersheds in the project area, the average number of acres currently meeting SALT criteria is 44,724. Under the proposed action, this number would increase to 77,397 acres by 2039. While this acreage is lower than the acres meeting SALT criteria in 2039 for the no action alternative it does not take into the account the potential large scale mortality of trees as a result of a large fire or insect outbreak. Under this alternative, prescribed cutting and prescribed burning would occur over much of the

landscape. Modeling indicates that the number of acres meeting SALT criteria would increase as a result of the proposed action, but at a slower rate than the no action alternative. With design features in place during implementation, large trees meeting the large and old growth tree implementation plan criteria would be retained, resulting in more large trees being left at the expense of smaller tree sizes. This would allow the number of SALT acres to increase over time. During implementation, some large trees would be cut in accordance with the large and old growth tree implementation plans. Remaining larger trees would be less susceptible to mortality from drought, insects, disease, and wildfire (Das et al. 2011, Ritchie et al. 2008). This lower number of SALT acres over the no action alternative does not take into account the application of the LTIP that would effectively increase the number of large trees remaining across the landscape.

This alternative would result in a lower risk of mortality, especially for larger trees, because of a decreasing risk of infection from pests or disease (Fischer et al. 2010), high-severity or uncharacteristic wildfire (Coop et al. 2016, Fiedler et al. 2010), or increased drought stress from competition (Erickson and Waring 2014). A number of studies have found that lower forest density leaves large and old trees less susceptible to mortality as a result of these factors. Erickson and Waring (2014) concluded that, “treatments removing small, neighboring trees may be critical in maintaining old ponderosa in the landscape, particularly under future climate change and increasing drought frequency in the western USA.” Modifying forest conditions to facilitate low severity fire on the landscape has been identified as a key condition to preventing increased mortality of large and old trees over the next several decades (Fiedler et al. 2007, Kolb et al. 2007, Ritchie et al. 2008). While this alternative may increase the amount of SALT acres at a slower rate than the no action alternative, the resulting forest would be far less likely to experience substantial loss of old and large trees as a result of various forest disturbances (such as uncharacteristic wildfire). A potential result of this alternative would be additional SALT acres than the no action alternative in the presence of large-scale disturbances.

Under this alternative, Forests would be able to manage more acres of naturally occurring wildfires for resource benefit. Forest structure, including openings, interspace, and groups and clumps of trees would allow for low to moderate fire severity that would maintain openings and have little potential effect on the vegetation resource except for trees in the smaller size classes. For a more thorough description of post treatment fire behavior consult the fire ecology specialist report in the project record.

Forest Process

Insects

Under alternative 2, the proportion of acreage with a high hazard rating for bark beetles would decrease from 69 percent to 5 percent in 2029 and to 3 percent by 2039. Stands with a low or moderate beetle hazard rating, the desired condition, would increase from 31 percent currently to 95 percent in 2029 and then 97 percent by 2039. This demonstrates a considerable shift toward the desired condition for this indicator. While the proportion of acreage with a moderate rating would change only slightly, the proportion of acreage with a low hazard rating would increase considerably as the analysis area approaches desired condition for this indicator.

Stands with lower tree densities and basal area are more resilient to drought and beetle attacks. Bark beetle population dynamics suggests that homogenous, dense stands are highly susceptible to beetle outbreaks. The proposed action would create heterogeneous, open, uneven-aged stands that would dramatically reduce susceptibility and maintain that reduced susceptibility over time. Susceptibility to western pine beetle would decrease over time with mechanical treatment and reintroduction of low severity surface fire. Areas with the greatest likelihood of infestation from bark beetles are areas treated at a low intensity as to not considerably affect beetle hazard rating. Additionally, areas with large amounts of

slash remaining post treatment are at risk for ips beetles. Some susceptibility to ips would continue to increase, with activity most likely occurring in response to a drought or a snow or ice event that creates fresh pine debris.

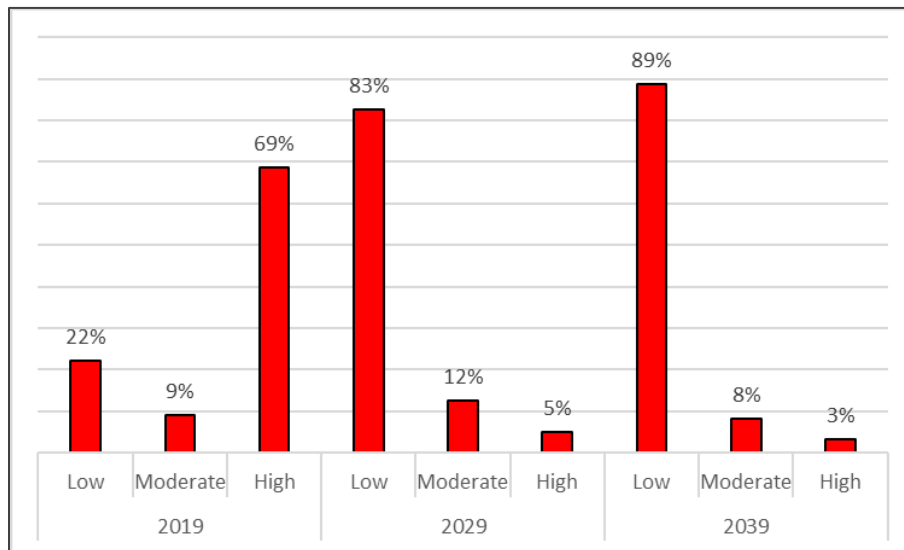


Figure 34. Alternative 2 – modified proposed action – distribution of bark beetle hazard rating classes across the analysis area

Disease

Currently, approximately 71 percent of the area is not infected or has a low infection level, 26 percent has a moderate severity rating, and 4 percent, or 25,485 acres, has a high severity rating. As a result of alternative 2, stands with a high severity rating would drop to 3 percent and stands with a Low or None rating drop to 61 percent by 2039. Acres with a moderate rating would increase to 31 percent as infection intensification and spread occur even after mechanical treatment. Dwarf mistletoe infections may be reduced as a result of alternative 2, but may intensify in remaining or latent infected trees, surrounding trees, and infected residual overstory trees, reducing the growth, vigor and longevity of ponderosa pine (Conklin and Fairweather 2010). However, across the analysis area, growth, longevity, and vigor of ponderosa pine trees would be increased. Though most of the analysis area would meet the desired condition of having low or no dwarf mistletoe severity, 39 percent of the analysis area would have a moderate or severe dwarf mistletoe severity rating by 2039 and would not meet the desired condition. This would be an improvement in dwarf mistletoe severity rating over the no action alternative by the year 2039.

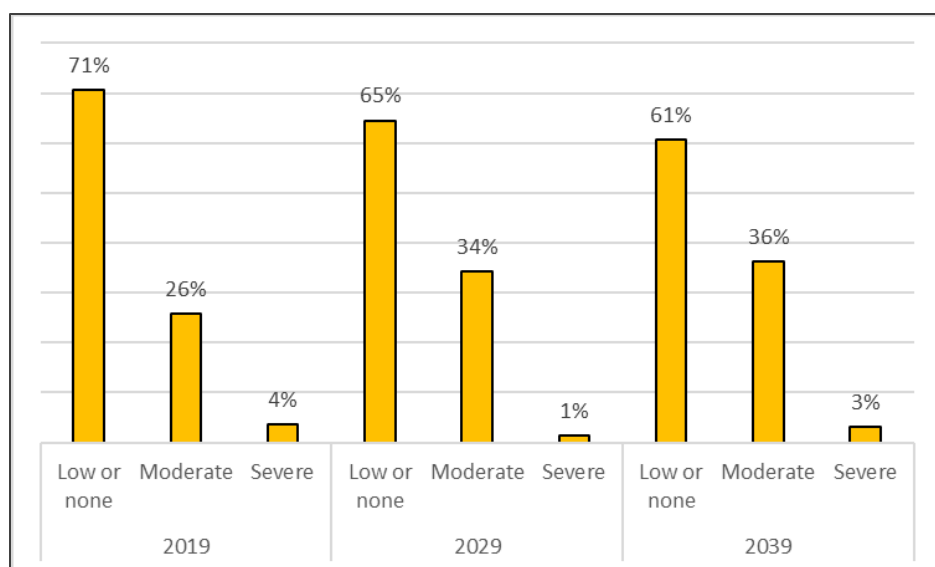


Figure 35. Alternative 2 – modified proposed action – dwarf mistletoe severity rating classes across the analysis area

Fire Adaptation

For a more thorough discussion of this alternative in terms of fire adaptation, consult the Fire Ecology Specialist report (USDA FS 2022). In general, this alternative would support the purpose and need to develop or return to a forest ecosystem that is fire-dependent, resilient, diverse, and sustainable. This alternative would support the shift away from larger high-severity crown fires to conditions that are more likely to support increasingly frequent, low severity surface fires (Cooper 1960, Swetnam 1990, Covington and Moore 1994a, Kolb et al. 1994, Swetnam and Baisan 1996). Over time this alternative would create conditions that resemble the natural range of variation of the native microbes, plants, and animals living in western ponderosa pine and dry mixed conifer forests (Covington and Moore 1994a, Reynolds et al. 2013). As a result, the analysis area would have reduced susceptibility to undesirable fire behavior and effects as well as other disturbance agents, such as bark beetles and disease, over time.

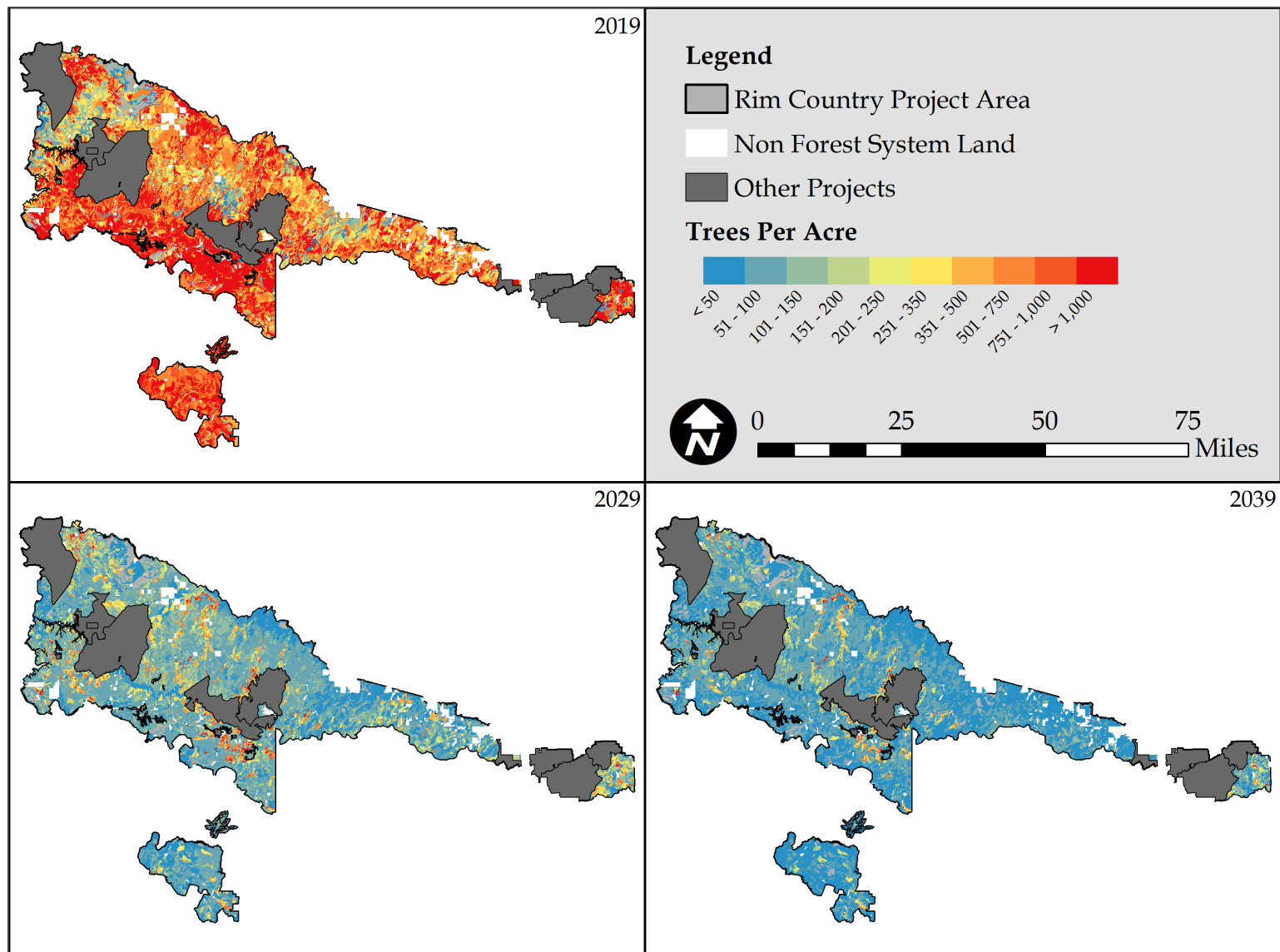


Figure 36. Alternative 2 – modified proposed action – trees per acre

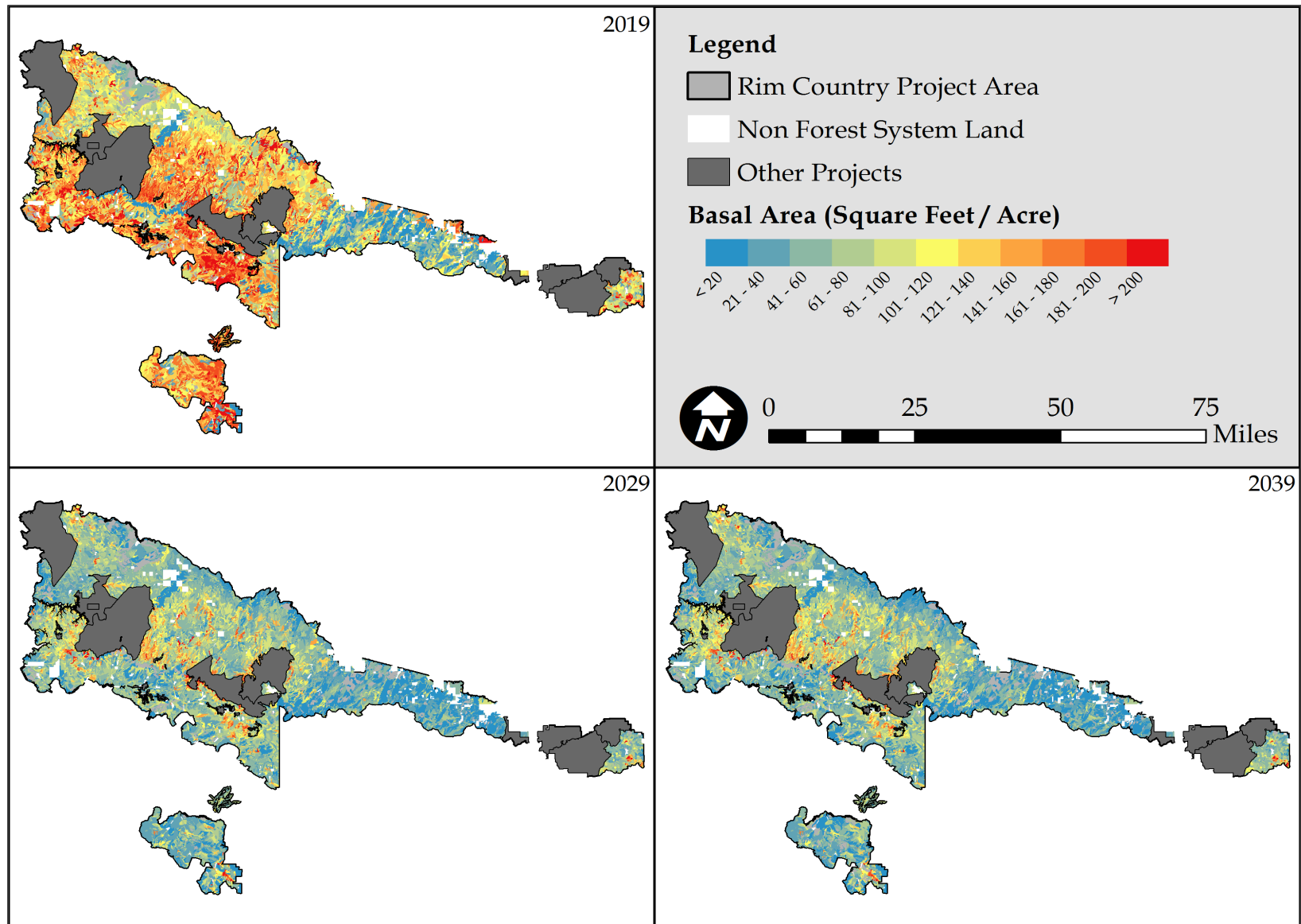


Figure 37. Alternative 2 – modified proposed action – basal area

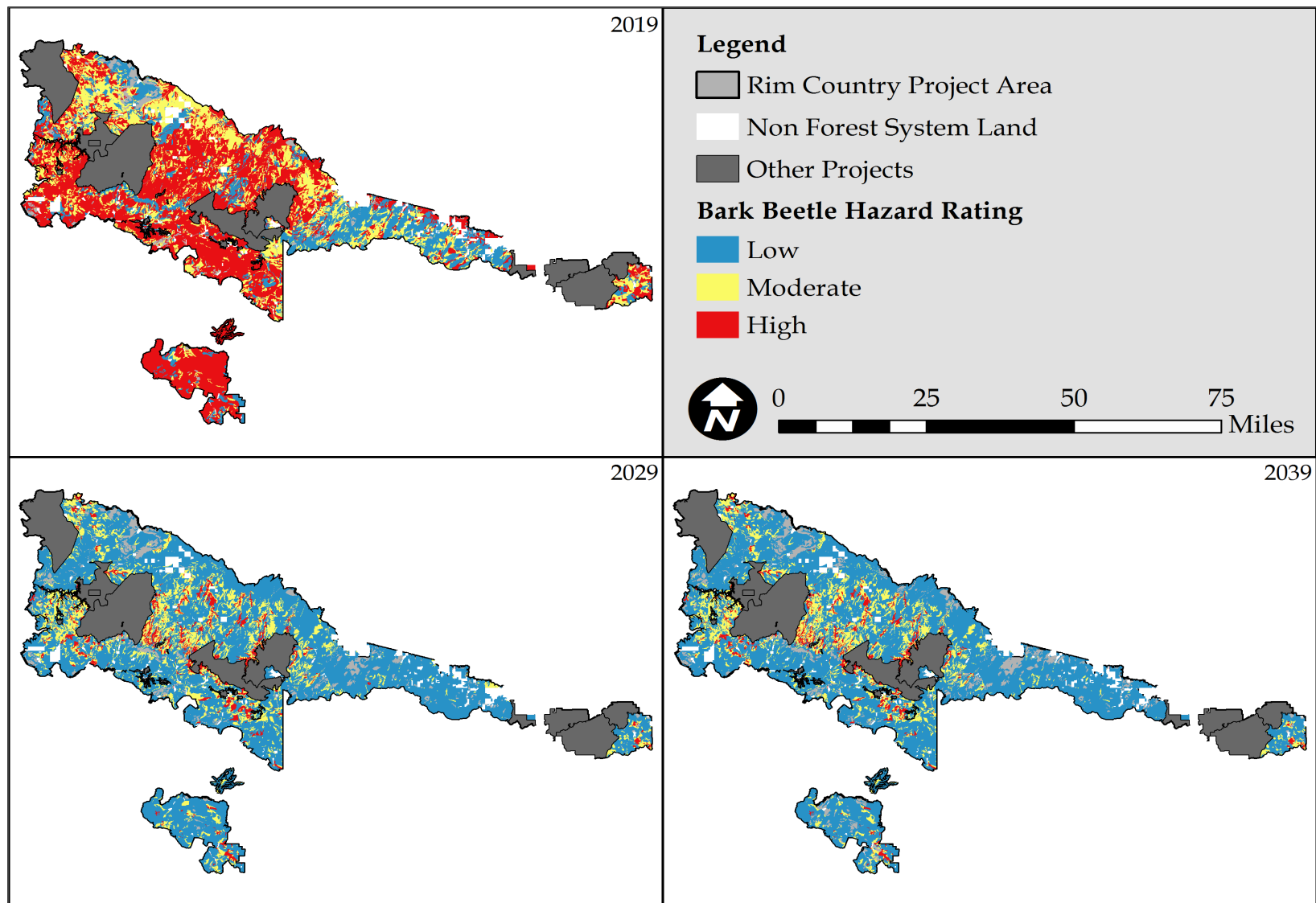


Figure 38. Alternative 2 – modified proposed action – bark beetle hazard rating

Alternative 3 – Focused Restoration

Direct and Indirect Effects

In general, many of the direct and indirect effects of alternative 3 would fall somewhere between those of the alternative 1 and alternative 2 or similar to alternative 2 with somewhat muted effects due to the limited number of acres treated. Under alternative 3, prescribed cutting using ground-based or cable operations and/or prescribed fire treatment would be applied over a portion of the analysis area in order to move toward or meet the desired conditions. This alternative meets or moves the project area toward the desired conditions identified in the land management plans and moves the project area forward in initiating the re-establishment of a fire-dependent, resilient, diverse, and sustainable forest ecosystem over the portion of the project area that would be treated. For a more thorough analysis of the effects of this alternative on the wildfire hazard, consult the fire ecology specialist report (USDA FS 2022). Many other areas that did not receive treatment would not move toward the desired conditions identified for this project and may further depart desired conditions in the future. The distribution of trees across size classes is more representative of a historic size class distribution as many trees in the smaller size classes have been removed or burned. At a landscape scale, forest composition, structure, pattern, and process would all be improved, but to a lesser extent than alternative 2.

Stand and landscape resilience to disturbances such as multi-year drought, pests and disease such as bark beetle and mistletoe, and wildfire would increase (Abella, et al. 2007), although to a lesser extent than with alternative 2. Drought stress and insect attacks associated with increased tree density, altered tree spatial arrangement, would be reduced. These changes in forest structure would reduce tree mortality due to decreased competition among trees in stands that were treated (Kane et al 2014). At the fine scale, forest structure and pattern would be improved in treated areas as vegetation management activities would maintain or improve the level of tree aggregation (groups and clumps of trees), and as existing groups are maintained and new groups are created (Zhang et al 2013).

Composition

Forest composition would improve under this alternative, although to a lesser extent than alternative 2. Ponderosa pine would still be the dominant forest cover type. Mixed conifer would continue to make up a moderate proportion of the analysis area, however shade tolerant species such as white fir may increase compositionally in untreated stands. As a result of prescribed cutting using ground-based or cable operations and prescribed fire in areas proposed for treatment, prevalence of later seral species such as white fir and corkbark fir would be reduced and would better represent their role in the natural range of variation. Pinyon Juniper woodlands and oak species would continue to make up a considerable part of the analysis area. The treatment of encroached grasslands would expand their range to more fully represent the natural range of variation, although to a lesser extent than the alternative 2. The protection and improvement of aspen stands would promote regeneration and reduce inter-tree competition and improve their condition under this alternative. The condition of less common but important species such as maple and Emory oak would be improved in treated areas.

This analysis has considered the effects of a changing climate. Though this alternative would result in a landscape more resilient to climate change than the no action alternative, climatic models for the southwestern U.S. predict continued warming, greater variability in precipitation, and increased drought. These climatic changes would likely contribute to some level of tree mortality; however, considerably less than the no action alternative. A changing climate may lead to large shifts and contractions in the range of dominant trees throughout much of the region (Kane et al. 2014).

Structure

Uneven-aged Structure

It is desirable for uneven-aged forest structure to occur on a majority of acres. Under this alternative, there would be a change to forest structure (figure 39) on the acres proposed for treatment, however large untreated areas would see little change to existing forest structure. This alternative would meet the Desired Condition for uneven-aged structure in the land management plans, however forest structure would more closely resemble natural range of variation in treated stands. Modeling indicates that some stands would move toward more even-aged conditions in the dominant cover types proposed for treatment as a result of removal of trees from the smaller size classes and retention of trees in the larger size classes. However, as treatments are applied on the ground, the use of the large and old tree implementation plans, in accordance with an uneven-aged thinning strategy, would be able to produce uneven-aged conditions across much of the landscape. In treated stands, individual tree growth would increase and trees would move into larger size classes as a result of a reduction in individual tree competition. Naturally-occurring regeneration would provide additional vertical structure over time.

An additional, and potentially more substantial, benefit to forest structure would be a reduction in the possibility of an uncharacteristic wildfire or other substantial disturbance event, such as a beetle outbreak or long-term drought. Under this alternative, treated stands would be more resistant to uncharacteristic fire and insect outbreaks and more resilient to drought. The balance of size classes and uneven-aged structure would provide conditions favorable to restoration of a natural fire regime in the areas proposed for treatment. In areas of untreated stands, the potential for uncharacteristic fire or other substantial disturbances would persist as well as their associated effects on forest structure.

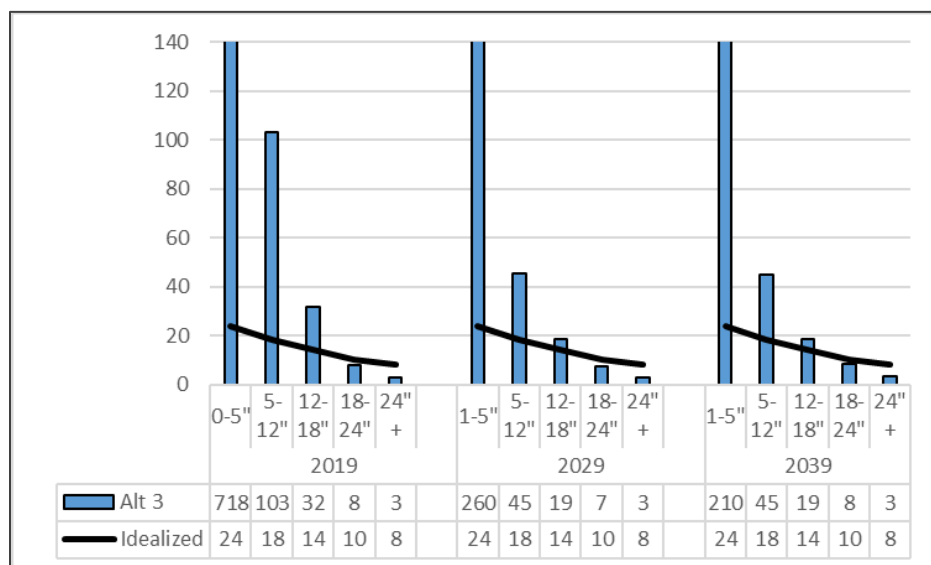


Figure 39. Alternative 3 – focused restoration alternative – distribution of trees per acres across size classes across the analysis area as well as idealized size class distribution

Density

Measure of density in this analysis include trees per acre, basal area and stand density index. On a portion of the project area prescribed fire and thinning would change the size class distribution of trees.

Alternative 3 would meet the desired condition on a smaller portion of acres as compared to alternative 2. The overall tree density would decrease under this alternative, with 863 trees per acre currently, 335 in

2029 and 285 trees per acre in 2039. While the initial reduction in trees per acre would result from a combination of mechanical and prescribed fire activities, the reduction after 2029 can be attributed to the recurring prescribed fire over time. Prescribed fire could more likely be used to balance the size classes at the lower end of the VSS distribution and move the landscape toward the desired condition. For example, prescribed fires with higher severity effects (such as, burning under hotter and/or dryer conditions) from 2029 to 2039 could be implemented to maintain the desired size class distribution at the lower end and better meet the desired condition.

Similar to alternative 2, the reduction in tree density would increase individual tree growth and reduce density dependent tree mortality. Understory grasses, forbs, herbs, and shrubs would increase in quantity in treated areas (Covington & Moore, 1994a).

Like many of the other indicator measures, the effects of the Focused Restoration alternative on trees per acres would resemble those of alternative 2, only to a lesser degree. It is important to note that this is because fewer acres would be treated compared to alternative 2; however those acres that would be treated would still be treated at the same intensity as alternative 2.

The desired condition is to retain a basal area of between 30 and 90 square feet per acre across most habitat types outside of Mexican spotted owl protected activity centers. While the land management plans provide a desired condition with a range of basal areas ranging from 20 to 180 square feet per acre depending on cover type, for this analysis, at the project level, for ease of comparison of effects between alternatives, 90 square feet per acre is the breakpoint for the resource measure across the analysis area. For both mixed conifer and ponderosa pine cover types it is desired to maintain basal area at less than 90 square feet per acre, though exceptions exist to provide heterogeneity across the landscape as well as specific wildlife needs for dense and closed canopy forest conditions. For a more thorough analysis of the effects of this alternative within Mexican spotted owl and northern goshawk habitat, consult the Wildlife Specialist report (USDA FS 2022).

Under alternative 3, basal areas across the analysis area average would be reduced to 75 square feet per acre in 2029 and 79 square feet per acre in 2039. While currently only 25 percent of stands meet the desired condition, by the year 2029, 52 percent of stands would meet the desired condition and by 2039, 49 percent of stands would meet the desired condition. This would result in decreased inter-tree competition for resources such as water, light, growing space and nutrients in treated areas. Individual tree growth would increase and density dependent mortality would be dramatically reduced along with susceptibility to potential insect and disease outbreaks. These conditions would indicate a shift from the current larger and higher intensity fires that the forest would currently experience to cooler, higher frequency, lower severity surface fires (Cooper, 1960) (Swetnam, 1990) (Covington & Moore, 1994a) (Kolb, Wagner, & Covington, 1994) (Swetnam & Baisan, 1996) that persisted prior to European settlement.

While some effects such as increased diameter growth and reduced competition would be reduced only in treated stands, other effects, such as landscape level insect hazard and fire severity, may extend to untreated areas. The reductions in basal area would allow the treated areas to meet the desired conditions and purpose and need for fire-dependent, resilient, diverse, and sustainable forest ecosystems at the landscape and watershed scales.

While some watersheds would have their average basal areas reduced to within the desired condition as a result of proposed activities, some watersheds such as Rye Creek-Tonto Creek and Lower Clear Creek would experience additional mortality as a result of prescribed fire between 2029 and 2039. This is a similar effect as with alternative 2 and is a result of the intensity of the prescribed fire modeled, as well as

the fact that most of the acres proposed for treatment in alternative 2 were also proposed for treatment in alternative 3. Prescribed fires with lower severity effects (such as burning under cooler and/or wetter conditions) from 2029 to 2039 could be implemented to maintain the desired basal area and continue to meet the desired condition in some watersheds.

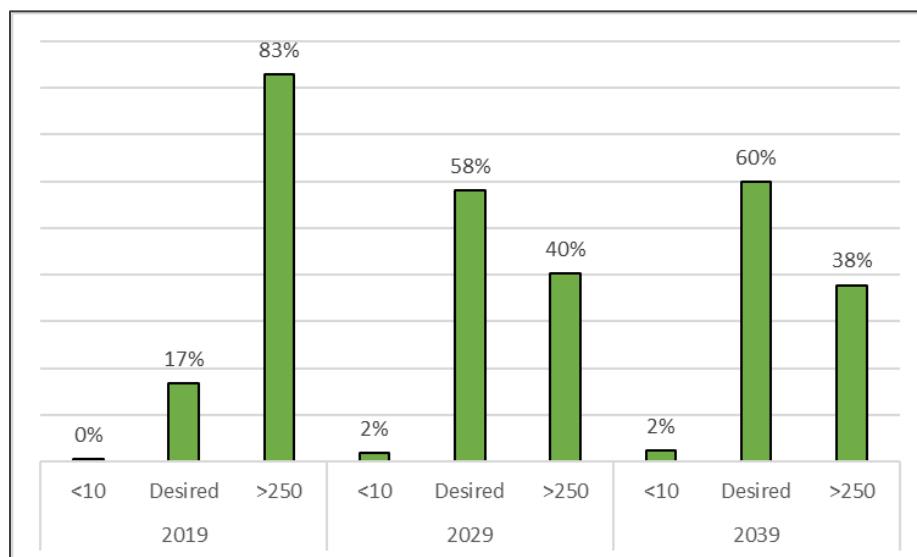


Figure 40. Alternative 3 – focused restoration alternative – percent of acres meeting desired condition for trees per acre across the analysis area

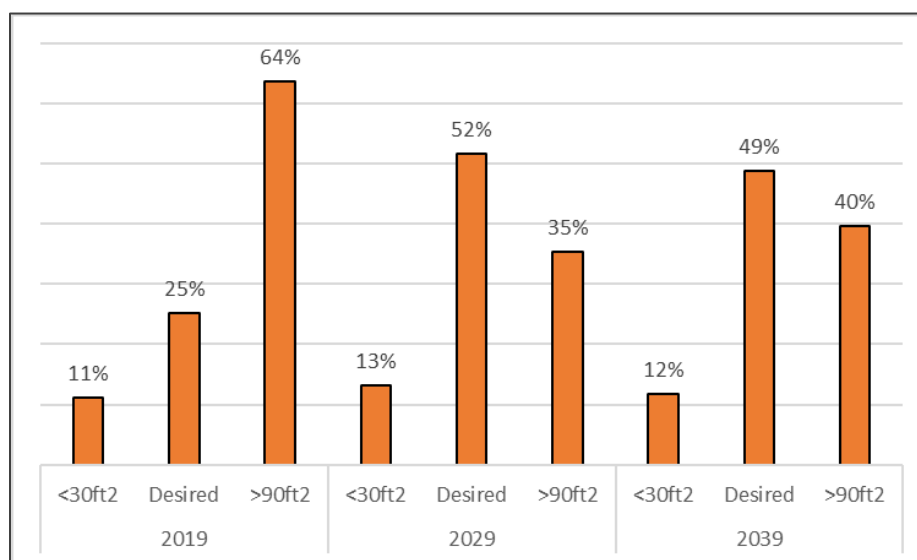


Figure 41. Alternative 3 – focused restoration alternative – percent of acres meeting desired condition for basal area across the analysis area

Stand Density Index (SDI) is a measure of relative stand density based on the number of trees per acre and the mean diameter (Long 1995). Percent SDImax expresses the actual density in a stand relative to a theoretical maximum density possible for trees of that diameter and species. SDI is a good indicator of how site resources are being used by taking both average tree size and trees per acre into account. SDImax represents an empirically-based estimate of the maximum combination of quadratic mean diameter and density which can exist for any stand of a particular forest type.

The desired condition for SDI is to be between 25 percent and 45 percent of SDIMax or between 112.5 and 202.5. Currently across the analysis area, SDI averages 263 or 58 percent of SDIMax and is considered extremely high. As a result of alternative 3, SDI would be reduced to 150 or 33 percent of SDIMax by 2029 and 151 or 34 percent of SDIMax by 2039. While currently 15 percent of the acres in the analysis area meet the desired condition, as a result of alternative 3, 30 percent would meet the desired condition and 22 percent would in 2039.

SDI values between 25 percent and 45 percent of SDIMax are associated with maximum understory production and maximum individual tree diameter growth as overall stand growth is concentrated on fewer trees. Depending on the level of tree aggregation, little inter-tree competition would be occurring. Competition may still be occurring within dense tree groups regardless of stand level SDI values.

Over time with alternative 3, stand densities should stabilize in treated areas as the reintroduction of fire returns natural disturbance processes to the landscape. This would result in reduced susceptibility to insect epidemics, particularly bark beetles as well as reduced density dependent mortality, increased individual tree diameter growth, and forage production over time and continued attainment of the desired condition.

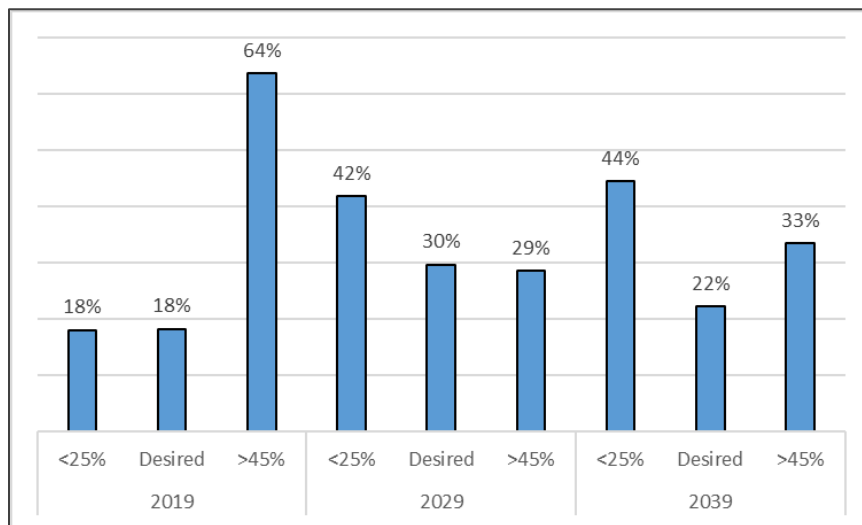


Figure 42. Alternative 3 – focused restoration alternative – percent of stands meeting the desired condition for stand density index

Large Tree and Old Tree Structure

Ponderosa pine stands of post settlement trees where the basal area of ponderosa pine trees greater than 18" diameter at breast height is more than 40 square feet per acre can be considered stands with an abundance of large trees (SALT stands). These stands occur outside of Mexican spotted owl protected activity centers, Mexican spotted owl Recovery habitat, and wildland urban interface and are being identified for their distinctive forest structure.

Across all areas proposed for treatment under alternative 3, the total number of acres currently meeting SALT criteria is 31,325. Under the alternative 3, this number would increase to 51,822 acres by 2039.

The number of acres meeting SALT criteria would increase as a result of alternative 3, but at a slower rate than alternative 2. With design features in place during implementation, large trees meeting the large and old growth tree implementation plan criteria would be retained, resulting in more large trees being left at the expense of smaller tree sizes. This would allow the proportion of stands meeting desired condition for

large trees to actually increase over time. During implementation, some large trees would be cut in accordance with the large and old growth tree implementation plans in order to meet the desired condition. In treated areas, remaining larger trees would be less susceptible to mortality from drought, insects, disease, and wildlife (Das et al. 2011, Ritchie et al 2008), whereas in untreated areas, susceptibility to these disturbance agents would continue to increase. This slower rate of SALT acre recruitment does not take into account the application of the Large Tree Implementation Plan that would effectively increase the number of SALT across the landscape at the expense of trees in the smaller size classes.

This alternative would result in a lower risk of mortality in the stands that were treated, especially for larger trees, because of a decreasing risk of infection from pests or disease (Fischer et al. 2010), high-severity or uncharacteristic wildfire (Coop et al. 2016) (Fiedler et al. 2010), and drought stress from competition (Erickson & Waring, 2014). A number of studies have found that lower forest density leaves large and old trees less susceptible to mortality as a result of these factors. Erickson and Waring (2014) concluded that, “treatments removing small, neighboring trees may be critical in maintaining old ponderosa in the landscape, particularly under future climate change and increasing drought frequency in the western USA.” While this alternative may increase the amount of acres meeting SALT criteria as a slower rate than the no action alternative, the acres proposed for treatment would be far less likely to experience substantial loss of old and large trees as a result of various forest disturbances (such as uncharacteristic wildfire).

In untreated areas, the effects would be similar to the no action alternative and would result in a higher risk of mortality, especially for larger trees, because of an increasing risk of infection from pests or disease (Fischer et al. 2010), high-intensity or uncharacteristic wildfire (Coop et al. 2016) (Fiedler et al. 2010) or increased drought stress from competition (Erickson & Waring, 2014). While this alternative may increase, on untreated areas, the amount of SALT acreage based on model results, these results do not account for the likely substantial loss of old and large trees as a result of various forest disturbances (such as uncharacteristic wildfire), which would decrease the amount of old and large trees and SALT acreage in the analysis area.

Forests would have the ability to manage more acres of naturally occurring wildfires to benefit forest resources, mainly within watersheds that have a considerable portion proposed for treatment. In treated areas, forest structure, including openings, interspace, and groups and clumps of trees would allow for low to moderate fire severity that would maintain opening and have little potential effect on the vegetation resource except for trees in the smaller size classes.

Under this alternative, on untreated acres where wildfires are managed for resource benefit, they may have the effect of reducing basal area and SDI by killing small trees or groups of small and/or intermediate aged trees. These fires could also result in mortality of some large and old trees. Based on those areas of recent wildfires that were managed for resource benefits, this effect would be very limited across the landscape in untreated areas. For a more thorough description of post treatment fire behavior consult the Fire Ecology Specialist Report.

Forest Process

Insects

Under this alternative, the proportion of acreage with a high hazard rating for bark beetles would decrease from 69 percent to 34 percent in 2029 and to 37 percent by 2039. The majority of acres that would remain with a high hazard rating are as a result of a lot of acres remaining untreated. While the proportion of acreage with a moderate rating would change only slightly, the proportion of acreage with a low hazard

rating would increase considerably as the analysis areas approach desired condition for this indicator. Stands with a low or moderate bark beetle rating, the desired condition, would increase from 31 percent currently to 66 percent in 2029 and 63 percent by 2039.

Stands with lower tree densities and basal area are more resilient to drought and beetle attacks. Bark beetle population dynamics suggests that homogenous, dense stands are highly susceptible to beetle outbreaks. Alternative 2 would create heterogeneous, open, uneven-aged stands that would dramatically reduce susceptibility and maintain that reduced susceptibility over time. Susceptibility to western pine beetle would decrease over time with mechanical treatment and reintroduction of low severity surface fire. Areas with the greatest likelihood of infestation from bark beetles are areas treated at a low intensity as to not considerably affect beetle hazard rating. Additionally, areas with large amounts of slash remaining post treatment are at risk for ips beetles. Some susceptibility to ips would continue to increase with activity most likely occurring in response to a drought or a snow or ice event that creates fresh pine debris.

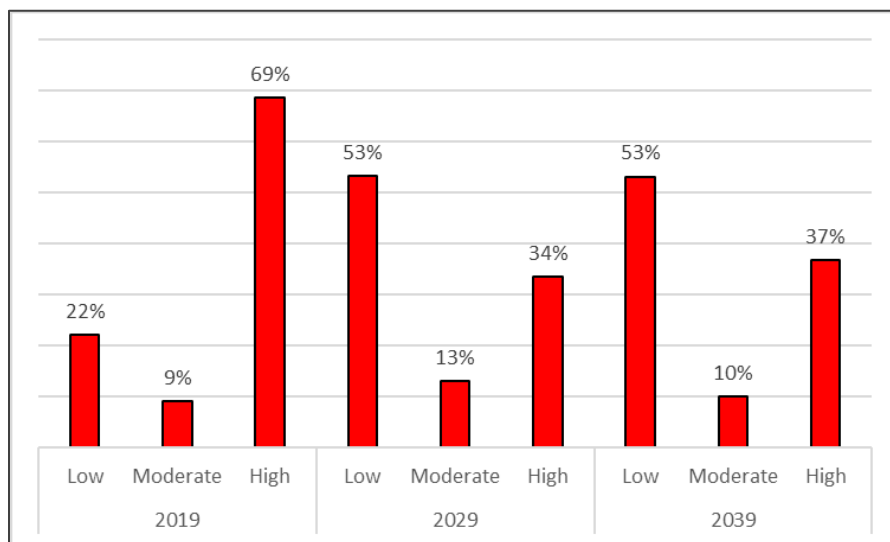


Figure 43. Alternative 3 – focused restoration alternative – distribution of bark beetle hazard rating classes across the analysis area

Disease

Currently, across the analysis area, approximately 71 percent of the area is not infected or has a low infection level, 26 percent has a moderate severity rating and 4 percent has a high severity rating. Initially, as a result of alternative 3, stands with a high severity rating would drop to 2 percent and stands with a Low or None rating would increase to 63 percent by the year 2029. The effects of the mechanical treatment and prescribed fire would diminish over time as acres with a severe rating increase to 4 percent and acres with a Low or None rating decrease to 60 percent by 2039, as a result of infection intensification and spread occurring even after treatment over some of the analysis area. With the exception of the change in severe infection, this result would be similar to the effects from alternative 2.

In areas not treated under this alternative, dwarf mistletoe infections may intensify and spread to surrounding trees, reducing the growth, vigor, and longevity of ponderosa pine (Conklin and Fairweather 2010). However, across the analysis area, growth, longevity, and vigor of ponderosa pine trees would be increased, approaching the desired condition. This is an improvement in dwarf mistletoe severity rating over the no action alternative by the year 2039, as the reduction in severely infected stands substantially affects forest health, growth, vigor, and resilience. In the untreated and severely infected stands, mistletoe

infection would intensify and spread over time. Dwarf mistletoe infections would not be reduced in these areas and may intensify in infected trees and the surrounding trees, reducing the growth, vigor, and longevity of ponderosa pine. These stands would further depart from the desired condition over time as infected stands intensify their infections and infect adjacent areas (Conklin and Fairweather 2010).

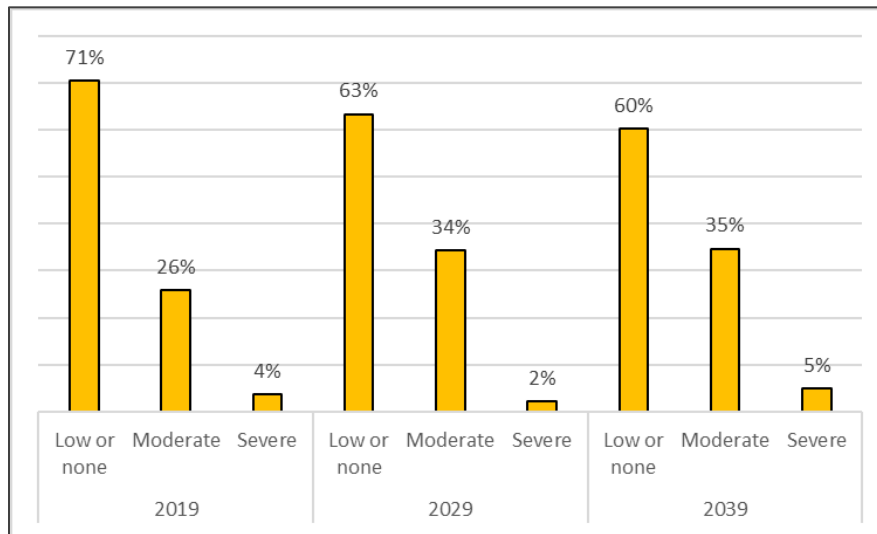


Figure 44. Alternative 3 – focused restoration alternative – dwarf mistletoe severity rating classes across the analysis area

Fire Adaptation

For a more thorough discussion of this alternative in terms of fire adaptation, consult the Fire Ecology Specialist Report (USDA FS 2022). In general, this alternative does support the purpose and need to develop or return to a forest ecosystem that is fire-dependent, resilient, diverse, and sustainable. In areas where treated, this alternative would support the shift away from larger high-severity fires to conditions that are more likely to support increasingly frequent, low severity surface fires (Cooper 1960) (Swetnam 1990) (Covington and Moore, 1994a) (Kolb et al 1994) (Swetnam and Baisan, 1996). Over time this alternative would create conditions that resemble the natural range of variation of plants and animals living in western ponderosa pine and dry mixed conifer forests (Covington and Moore 1994a, Reynolds et al 2013). As a result, in areas where treated, this alternative would reduce the susceptibility to uncharacteristically severe fires and other disturbance agents, such as bark beetles and disease, over time. Many areas not treated would remain susceptible to uncharacteristically severe fires and increase in vulnerability to other disturbance agents, such as bark beetles and disease, over time.

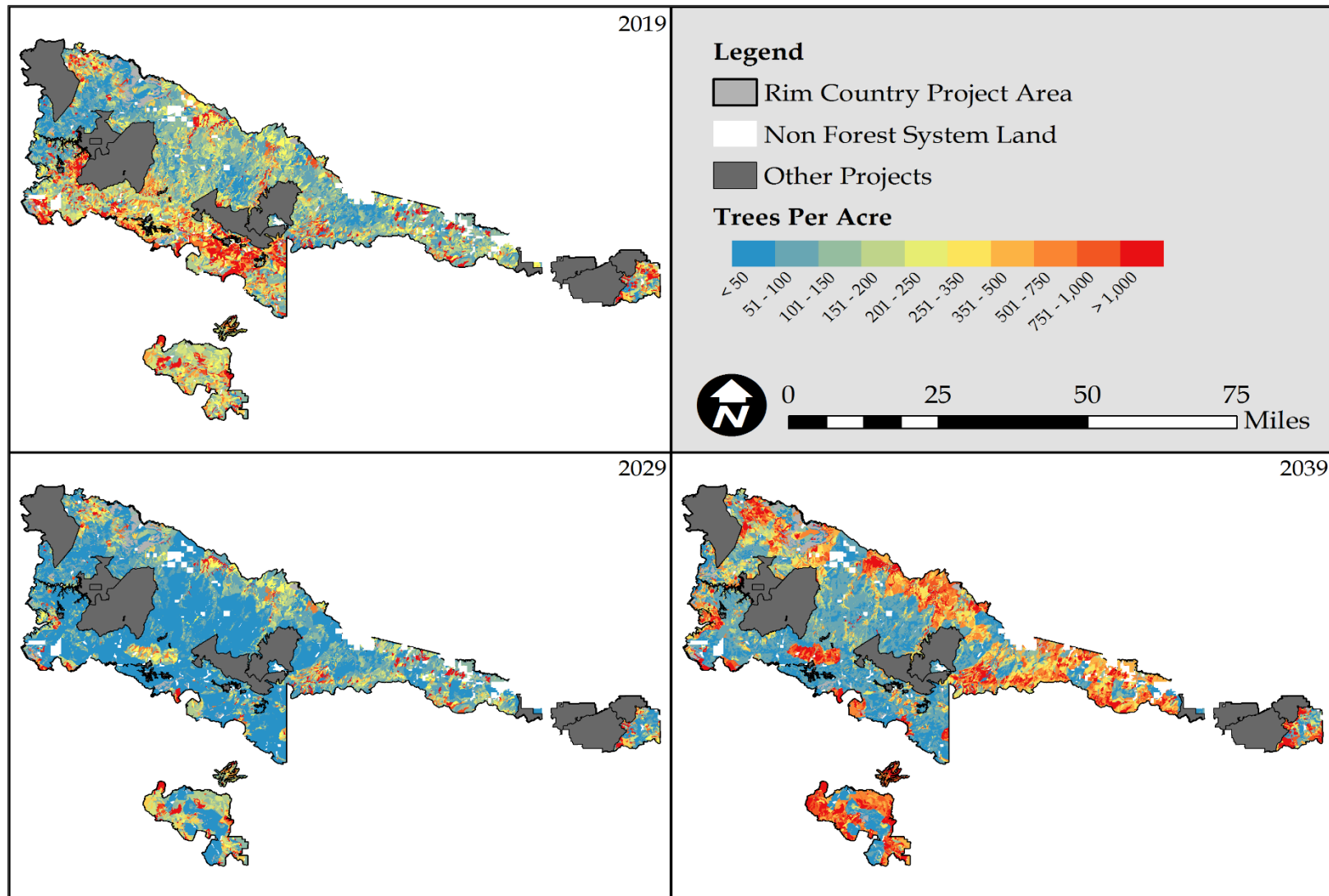


Figure 45. Alternative 3 – focused restoration – trees per acre

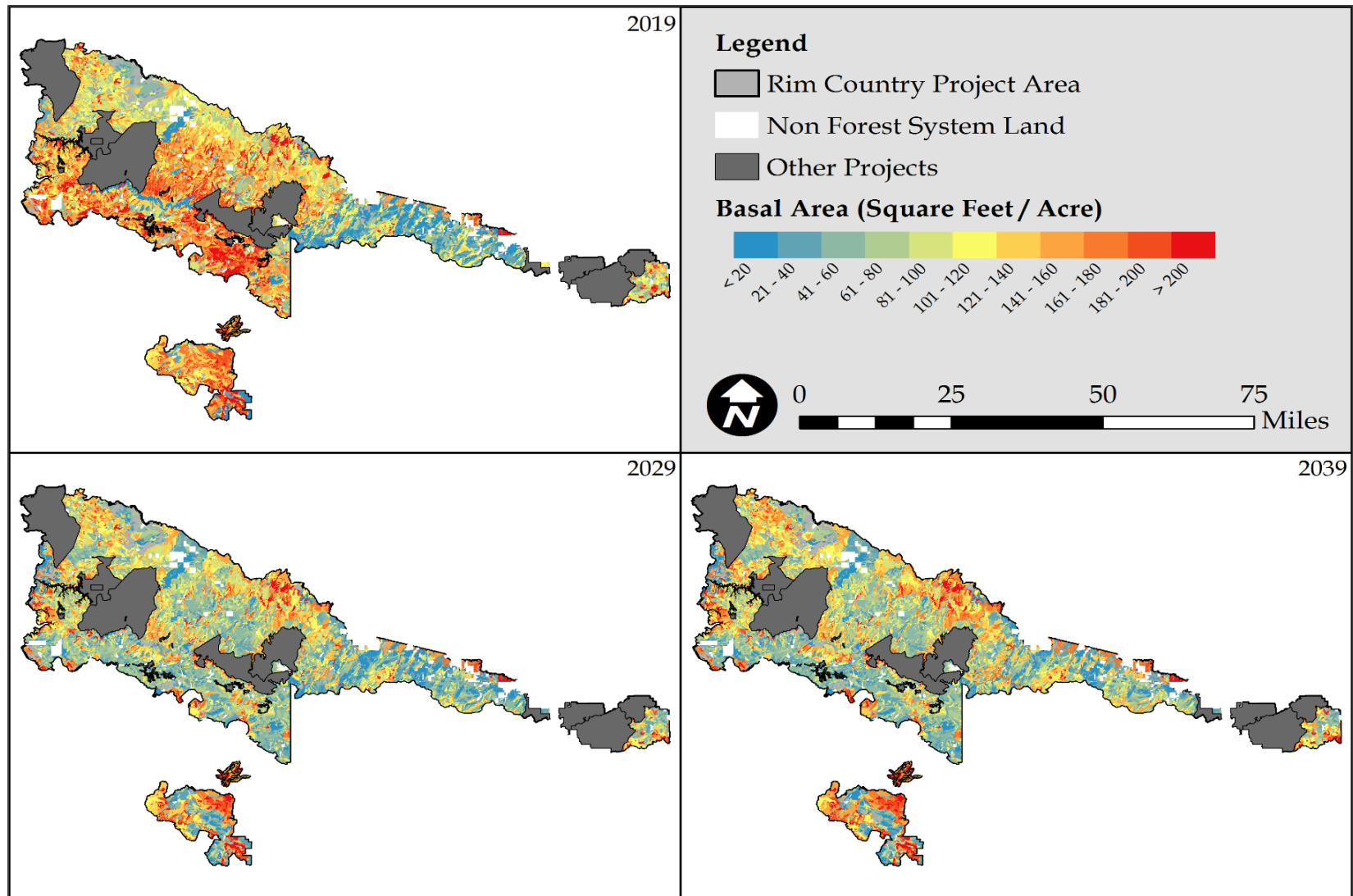


Figure 46. Alternative 3 – focused restoration – basal area

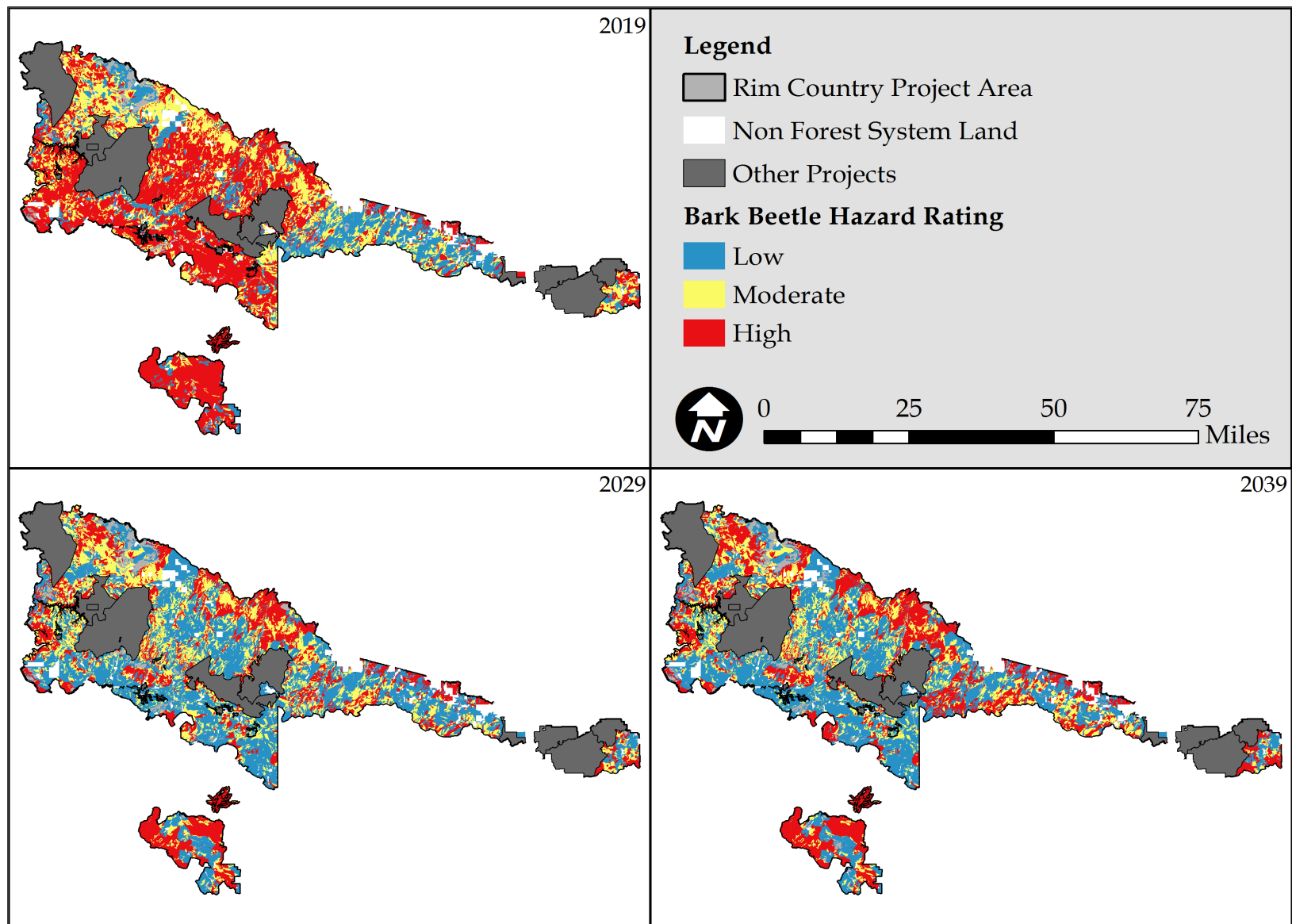


Figure 47. Alternative 3 – focused restoration – bark beetle hazard rating

Table 33. Summarized effects of the alternatives

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Forest Structure - General	Stand structure would continue to not meet the desired conditions as smaller trees are overrepresented. This trend would be expected to continue, leading to increased density dependent mortality, while basal area and stand density index (SDI) would continue to increase. The number of trees per acre and basal area and SDI would move further away from the natural range of variation (NRV) and the desired conditions. This trend would be expected to continue. Insect hazard rating and severity of dwarf mistletoe infections would continue to increase.	Stand structure would move toward desired conditions as trees would be well distributed across size classes. The number of trees per acre, basal area, and SDI would decrease considerably, trending toward desired conditions within NRV as a result of thinning and prescribed fire activities. Insect hazard rating and dwarf mistletoe severity would be reduced in treated areas, thus moving toward the desired conditions.	In general, the effects would be similar to the effects of Alternative 2, with a muted effect due to the fewer number of acres treated and would only be observed in the stands treated. The number of trees per acre, basal area, and SDI would decrease considerably, trending toward desired conditions within NRV as a result of thinning and prescribed fire activities. Insect hazard rating and dwarf mistletoe severity would be reduced in treated areas, thus moving toward the desired conditions.
Forest Structure - Pattern	Stands would continue to remain in a closed condition, lacking groups and clumps of trees or randomly spaced trees. Grasses forbs and shrubs would continue to be underrepresented. Forest structure would continue to be departed from historic conditions.	This alternative would generally meet the desired condition. The majority of stands would be in an open condition. Forest arrangement would be in individual trees, small clumps, and groups of trees or randomly spaced trees that are similar to historic patterns and are as a result of the proposed action. Most forest stands in uneven-aged condition to meet forest resilience and sustainability goals while maintaining wildlife habitat.	This alternative would generally meet the desired condition on the acres that were treated, however the acres that were not treated would resemble the conditions described in the no action alternative. Forest arrangement would resemble historic forest structure in some places, while many other areas would not meet the desired condition for forest pattern and structure.
Forest Structure – Trees per Acre	Total trees per acre continues to remain above the desired condition. The percentage of acreage in the project within desired condition moves up from 17 percent currently to 19 percent in 2039 as a result of density-dependent mortality. Tree distribution does not approximate the idealized distribution with too many trees in the smaller size classes. By 2039 there would be 553, 114, 36, 11, and 3 trees in the 0-5", 5-12", 12-18", 18-24" and 24"+ DBH size classes, respectively.	The percentage of acreage within desired condition for trees per acre increases dramatically from 17 percent currently to 93 percent in 2039. The distribution of trees across size classes approximates the idealized distribution by 2039 better than any of the other alternatives. By 2039 there would be 35, 12, 11, 7, and 3 trees in the 0-5", 5-12", 12-18", 18-24" and 24"+ DBH size classes, respectively.	Trees per acre: The percentage of acreage within desired condition for trees per acre increases from 17 percent currently to 60 percent in 2039. Tree distribution does not approximate the idealized distribution with too many trees in the smaller size classes. By 2039 there would be 210, 45, 19, 8, and 3 trees in the 0-5", 5-12", 12-18", 18-24" and 24"+ DBH size classes, respectively.
Forest Structure – Basal Area	Average basal area would continue to increase across the project area from 115 square feet per acre currently to 137 square feet per acre in 2039. The percentage of acres that would meet desired condition decreases from 25 percent currently to 19 percent by 2039.	Average basal area would decrease across the project area from 115 currently to 53 in 2039. The percentage of acres that meet desired condition would increase from 25 percent currently to 66 percent in 2039.	Average basal area would decrease across the project area from 115 currently to 79 in 2039. The percentage of acres that meet desired condition for basal area would increase from 25 percent currently to 49 percent in 2039.

Resource Area	Alternative 1 No Action	Alternative 2 Modified Proposed Action (Preferred Alternative)	Alternative 3 Focused Restoration
Forest Structure – Stand Density Index	Average stand density index would continue to increase across the project area from 263 currently to 296 in 2039. The percentage of acres that would meet desired condition decreases from 18 percent currently to 14 percent in 2039.	Average stand density index would decrease across the project area from 263 currently to 86 in 2039. The percentage of acres that meet desired condition would increase from 18 percent currently to 28 percent in 2029 and then 20 percent in 2039.	Average stand density index would decrease across the project area from 263 currently to 151 in 2039. The percentage of acres that meet desired condition would increase from 18 percent currently to 22 percent in 2039.
Forest Insects	The proportion of acreage that would meet the desired condition for bark beetle hazard decreases from 31 percent currently to 19 percent in 2039 as a result of increased stocking and lack of disturbance over time.	The proportion of acreage that would meet the desired condition for bark beetle hazard would increase from 31 percent currently to 97 percent in 2039.	The proportion of acreage that meet the desired condition for bark beetle hazard would increase from 31 percent currently to 63 percent in 2039.
Forest Disease	The proportion of acreage with a severe dwarf mistletoe rating would increase from 4 percent currently to 10 percent in 2039. The proportion of acreage that meets the desired condition decreases from 96 percent currently to 90 percent in 2039.	The proportion of acreage with a severe dwarf mistletoe rating would decrease from 4 percent currently to 3 percent in 2039. The proportion of acreage that meets the desired condition would increase from 96 percent currently to 97 percent in 2039.	The proportion of acreage with a severe dwarf mistletoe rating remains essentially unchanged from 4 percent currently to 5 percent in 2039. The proportion of acreage that meets the desired condition would decrease from 96 percent currently to 95 percent in 2039.

Cumulative Effects

For the cumulative effects analysis, the spatial context being considered is the 1,238,658-acre project area. Cumulative effects are discussed in terms of vegetation management and prescribed fire activities as well as the effects of wildfire that have occurred since as early as 1990, and as changes in the existing condition due to present and foreseeable activities, including the effects of the alternative being discussed. The baseline year used for this analysis is the year 2019 as the existing condition. In this analysis, all past activities and events are included in the existing condition description. In the effects discussion, post treatment refers to the time the final activity is accomplished (year 2019), “short-term” effects refers to effects over the 10-year period from the time the final activity was accomplished (year 2029). Beyond 20 years we will be considering effects as “long-term” (year 2049). All alternatives are compared across forest boundaries (Apache-Sitgreaves, Coconino, and Tonto Forests combined).

Vegetation Management Activities and Prescribed Fire

Table 28 lists approximate acres of the various vegetation management activities, prescribed burning, and other activities that have occurred within the project area as part of vegetation management projects from as early as 1990 to 2017. This includes 469,036 acres of mechanical vegetation management activities that mainly consisted of tree thinning involving heavy equipment and 567,935 acres of prescribed fire. Additionally, 122,264 acres of other activities have occurred in the project areas including 4,645 acres of wildlife habitat improvement, 7,694 acres of range vegetation control, 39,708 acres of range vegetation manipulation, 17,475 acres of tree encroachment control, 45,561 acres of tree release and weed, 15 acres of fuel compaction, 571 acres of fuels chipping, 2,749 acres of range forage improvement, 96 acres of special products removal, 203 acres of insect control and prevention, 1,256 acres of fuel breaks, 1,238 acres of planting, 616 acres of cultural site protection, 321 acres of scarification and seeding of landings and 116 acres of pruning. Table 28 includes reasonably foreseeable projects and activities with approximate acres of within the cumulative effects area. For additional information on the actions considered in this cumulative effects analysis, see chapter 3 of this EIS.

Fire

Wildfires from 1943 to 2020 (table 29) have burned on approximately 586,306 acres in or adjacent to the project area. Of these acres, it is estimated that the overall average fire severity to the vegetation was 20 percent high severity, 30 percent mixed severity, and 50 percent low severity. There is wide variability among these percentages from fire to fire. For more information on the history of wildfires in the project area consult the Fire Ecology Specialist report (USDA FS 2022).

Many of the wildfires that burned within the project area in the last 10 years were managed primarily for resource objectives instead of primarily for suppression, and they produced primarily low-severity fire effects. The vast majority of the mechanical thinning projects in the area have decreased the potential for active crown fire and crown fire initiation on acres thinned, the potential for crown fire initiation, and high-severity effects from surface fire. Past mechanical and prescribed fire treatments decreased the potential for crown fire by breaking up the vertical and horizontal continuity of canopy fuels.

Timber Harvest

Past timber harvest practices influenced vegetation structure, pattern, and composition on the majority of the project area. From the late 1880s to the 1940s, logging that facilitated construction of the railroads was conducted by several lumber and timber companies in the areas of Holbrook to Flagstaff (Lightfoot 1978). By 1940, much of the profitable lumber that could be easily accessed had been removed. In terms of vegetation structure, many of the largest and oldest tree sizes larger than 18” diameter at breast height

were removed from many areas. Extensive regeneration with no large trees interspersed within the younger age classes occupied many of the harvested areas. The pattern on the landscape no longer resembled the Desired Condition outlined in the land management plans.

Past timber sales within the project area such as the Ridge Analysis Area (1994), and Brookbank Multi-product Timber Sale (1994), implemented prior to the Southwestern Region's 1996 amendment of Land Management Plans, targeted the harvest of medium and large diameter trees. In some cases, all trees over 12 inches in diameter were removed. This affected the presence of pre-settlement trees and old forest structure.

Today, at the landscape (project area) scale, pre-settlement trees are underrepresented in many areas. The focus on even-aged forest management continued until the mid-1990s, leaving the legacy of current forest conditions. Approximately 50 percent of the project area that received some type of regeneration or shelterwood harvest has regenerated. Many stands are even-aged, dense, and lack age class diversity. Today, the majority of acreage can be classified as young and mid-aged forests with a moderately closed to closed tree canopies.

Post 1996 Vegetation Treatments – Uneven-aged Management, Fire Hazard and Restoration

After the region-wide 1996 amendment, vegetation objectives included uneven-aged management (figure 27 and figure 28). A review of the Forest Activity Tracking System (FACTS) timber database indicates that treatments designed to promote uneven-aged management began being recorded as early as 1991 on the Apache-Sitgreaves National Forest, in 1987 on the Coconino National Forest, and 2001 on the Tonto National Forest. However, acres treated in this category continued to be minor in comparison to acres treated with even-aged methods until about 2005. These acres treated using uneven-aged silviculture systems should today, still be moving these acres toward their desired conditions. Acres still assigned to even-aged silviculture may, or may not, be moving toward desired conditions depending on whether or not the stands can/could be converted to an uneven-aged structure or have been successfully regenerating. Forests in the project area use even-aged management to some extent and the use of this silvicultural system is not precluded in current land management plans.

After 1996, the objective of most vegetation projects in the project area was to reduce the risk of high-severity fire, improve forest health (stand and tree resilience and vigor), **increase individual tree diameter growth from lessened competition**, and improve understory diversity. Retention of snags and managing for coarse woody debris was further enhanced with the 1996 amendment and made part of project requirements. The 1996 Land Management Plan amendment also changed treatments in Gambel oak and the species was recognized for its role in managing for ecological diversity and high quality wildlife habitat.

With the exception of older projects that removed large, old trees and promoted even-aged management, most vegetation projects that contributed to the current condition within the project area occurred from 2000 to 2015. From 2000 to 2015, across the three Rim Country forests, examples of projects designed primarily to address the risk of undesirable fire behavior and effects in the project area include Heber-Overgaard wildland urban interface, Camp Tatiyee/Camp Grace Fuel Reduction, Forest Lakes wildland urban interface Treatment, Rim Top Prescribed Burn, Hilltop wildland urban interface, Whitcom wildland urban interface, Hilltop II Fuels Reduction, Little Springs wildland urban interface, Los Burros, Nutrioso wildland urban interface, Section 31 Fuels Reduction, Blue Ridge Urban Interface, Bald Mesa Fuels Reduction, Lake Mary Meadows Two Fuels Reduction, Upper Beaver Creek Watershed Fuels Reduction, Verde wildland-urban interface, Pine Strawberry wildland urban interface, Christopher Hunter wildland

urban interface, Cherry Prescribed Burn, Myrtle wildland-urban interface and Haigler Fuels Analysis among others (table 28). A variety of other projects have modified vegetation for other objectives such as grassland restoration, wildlife habitat improvement, maintaining rights of way, reforestation, noxious weeds and as well as transportation system management (table 28).

Natural Disturbances – Insect and Disease

Though many of the treatments identified in table 28 were designed to reduce hazard of insects and diseases, these natural disturbance mechanisms are still present in these forests. Though prescribed fire, or any fire, increases the short-term risks to bark beetle infestations, mechanical and prescribed fire treatments have worked to reduce insect and disease risk by reducing density in terms of basal area, stand density index and trees per acre. Historic treatments as well as the treatments in the Rim Country analysis have worked together to reduce insect and disease risks. A comprehensive account of insect and disease activity occurring within the project area and cumulative effects area was provided by USDA Forest Health Protection (USDA Forest Service 2016). Much of the information in that report comes from a combination of the Historical Reports for the three forests (Lynch et al. 2008, 2010, 2015), and aerial detection survey (ADS) data collected every year by Forest Health Protection (FHP) (USDA Forest Service 2016).

For the Rim Country project area, ADS indicates that activity of most agents has been relatively low for the past five years. In fact, much of the recent insect activity mapped in the project area occurred during the drought years from 2001-2005. Treatments listed in table 28 have maintained these low levels and additional treatments in the Rim Country Project should improve the resilience of these forested systems. More details on the specific agents are discussed within their specific forest type below. We should also note that there are many insects and diseases which cause little damage or tree mortality (Furniss and Carolin 1977). Their effects are not considered extensive and will not be discussed in this cumulative effects analysis.

Generally speaking, current stands of ponderosa pine and mixed conifer are much denser with smaller average diameters than what was historically present prior to European settlement (Covington and Moore 1994). This change in stand structure appears to have favored certain insects and diseases, primarily bark beetles and Southwestern dwarf mistletoe (Chojnacky 2000, Conklin 2000). Details on these are provided below. Root rot pathogens, although not specifically discussed by forest type, are present in all forest types. Root diseases can cause direct tree mortality and are often associated with secondary mortality such as bark beetle attacks (Fairweather et al. 2013). Root diseases are often missed during surveys because their deleterious effects are gradual. Some management activities in the cumulative effects area have targeted trees with root rot and reduced its prevalence.

Bark Beetles

The primary two genera found in ponderosa pine, *Dendroctonus* spp. and *Ips*, spp. are capable of causing substantial tree mortality. Historical activity of mountain pine beetle in ponderosa pine in Arizona has been limited to areas on the North Rim of the Grand Canyon (Blackman 1931, Lynch et al. 2008). There are also multiple species of ips beetles found in the ponderosa pine forests of north central Arizona (Williams et al. 2008).

Historical reports indicate that both the size of bark beetle outbreaks and the beetle species involved in the outbreaks have shifted since the early part of the century. Most tree mortality in the ponderosa pine early in the 1900s was predominately attributed to beetles in the *Dendroctonus* genus. While periodic ips beetle attacks were also reported on all three forests, earlier ips beetle outbreaks were localized events, associated with slash management issues from forest management activities, windthrow, and drought. In

contrast, the widespread, landscape-level tree mortality that occurred across the Rim Country Project area in the early 2000s was primarily attributed to ips beetle species, and correlated with a widespread drought. Within infected ponderosa pine stands, all three forests experienced substantial tree mortality from this outbreak with stand basal area declining by 37 percent, 32 percent, and 62 percent for the Apache-Sitgreaves Coconino, and Tonto National Forests, respectively (Negrón et al. 2009). Also observed was a reduction in tree density, SDI and average tree diameter. Probability of tree mortality was positively correlated with initial tree density and negatively correlated with elevation and initial average tree diameter (Negrón et al. 2009).

Dwarf Mistletoe

Southwestern dwarf mistletoe incidence has increased on all three Forests, with an estimated 52 percent, 32 percent, and 47 percent of commercial acres infected in the 1980s for the Apache-Sitgreaves, Coconino, and Tonto, and National Forests, respectively, versus only 19 percent 41 percent, and 30 percent, respectively, in the 1950s (Lynch et al. 2008, Lynch et al. 2010, Lynch et al. 2015). High dwarf mistletoe ratings increase tree stress and the likelihood of ips beetle attacks during drought (Kenaley et al. 2006, 2008). The prevalence of Southwestern dwarf mistletoe seems to be particularly high along the Mogollon Rim. For instance, incidence of mistletoe is higher on the Mogollon Ranger district than on any other district on the Coconino (48 percent of commercial timber infected) and is higher on the Black Mesa district than on the Lakeside district (Hessburg and Beatty 1985, as reviewed in Lynch et al. 2008, 2010). Denser stand conditions and fire suppression have increased mistletoe abundance in current forest stands, despite the fact that its distribution has likely not changed extensively (Dahms and Geils 1997).

Alternative 1 – No Action

There would be no changes in current management and the land management plans would continue to be implemented. The acres identified in table 28 for mechanical vegetation treatments, prescribed fire, and other activities in the form of past and ongoing projects would continue to impact the landscape. Additionally, the acres identified in table 28 for vegetation treatments, prescribed fire projects, and activities in other projects would continue to be implemented in the reasonably foreseeable future within the project area. It is expected that when these actions are completed that these acres would be moving toward the desired conditions. Alternative 1 is the point of reference for assessing action alternatives 2 and 3. The thinning and prescribed fires treatments in the prior 10-year period were designed to set up the stands to reach their desired conditions according to the then approved land management plans. In conjunction with mechanical treatments, there were prescribed fire only treatments designed as fuels treatments to reduce surface fuels as well as reduce ladder fuels and crown fire risks. To those ends, the prior treatments would move the treated acres toward their desired conditions.

Timber Harvest

Past timber harvest practices influenced vegetation structure, pattern, and composition on the majority of the project area. The focus on even-aged forest management continued until the mid-1990s, leaving the legacy of current forest conditions. Approximately 50 percent of the project area that received some type of regeneration or shelterwood harvest has regenerated. Many of these stands are two-aged, dense, and lack age class diversity as a result of these historic practices. Historically, wildfire would have maintained a diverse matrix of age class diversification. Reintroduction of an historical fire return interval would aid in converting, and maintaining, an uneven-aged forest at the landscape level. Currently planned forest treatments should move these stands toward a trajectory for their desired conditions. Untreated stands would continue to move away from desired conditions as densities increase, beetle risks increases and risks of crown fire increase. Under alternative 1, the potential for uncharacteristically large-scale wildfires that dramatically impact the landscape is increased.

The Cragin Watershed Protection Project on the Coconino National Forest would mechanically treat 41,046 acres and apply prescribed fire to 63,656 acres to move stands in that project area toward the desired condition in terms of fire behavior and stand structure. Fuels treatments following mechanical treatments designed to balance age classes provide the best chance to set these stands on a trajectory toward desired conditions. The Haigler Fuels Analysis on the Tonto National Forest planned to treat over 43,000 acres with mechanical and prescribed fire, but is still in the scoping phase and no impacts can be assigned other than to say that there is a need to reduce high fuel loadings and return to a natural regime.

Forest Structure

In alternative 1, few treatments would be implemented to create a mosaic of interspaces and tree groups. In locations not identified for treatment under other decisions, existing interspace would continue to be reduced by expanding tree crowns and increased tree densities. Understory vegetation response would be suppressed. The risk of undesirable fire and/or effects would continue to increase. Any large-scale tree mortality occurring has the potential to enhance interspace and create tree groups. While the forests in the project area have an emphasis to favor uneven-aged management, this silvicultural system does not assure interspaces and groups. These forests have latitude to create openings and groups but have not implemented large areas of openness to date except within wildland urban interface treatments. In terms of a mosaic of interspaces and tree groups at the landscape level the prior treatments have not significantly moved the forest toward the desired conditions at this time.

Forest Structure - All age and size classes represented

Prior thinning treatments with restoration objectives were similar to the northern goshawk habitat and Mexican spotted owl restricted other habitat treatments proposed under the first 4FRI EIS as well as this project and have resulted in similar diversity in age and size class, and should move these stands toward desired conditions. Uncharacteristically severe wildfires caused large-scale mortality across all age and size classes resulting in a non-stocked or single age class representation. Wildfires that burned with a low severity and prescribed burn only treatments had similar effects to forest structure as the post thinning prescribed fires. Restoration treatments and 4FRI treatments are designed to lessen the probability of these uncharacteristically severe wildfires.

The main objective of thinning with a fuels reduction emphasis was to reduce canopy fuels and the potential for crown fire initiation. Generally, this type of treatment focused on removal of trees in the subordinate crown positions and retaining those trees in the dominant and co-dominant crown positions and any pre-settlement trees. This type of treatment resulted in a moderately open canopy, even-aged forest structure with very little age and size class diversity. Prescribed burning and mechanical fuels treatments associated with the above thinning treatments resulted in periodic tree mortality of seedling/sapling size trees and susceptible pre-settlement trees further reducing age class diversity.

Old Forest Structure

Many prior thinning treatments retained pre-settlement trees and the largest post-settlement trees. Sanitation treatments may have removed some old forest structure. Prescribed burning and low severity wildfire resulted in periodic tree mortality of susceptible pre-settlement trees. Mixed and high-severity wildfire killed a large proportion of the old forest structure. Powerline treatments removed any old forest structure that was a hazard to the powerline.

Old forest structure has been reduced over many years by past management practices. The change in direction in 1996 to manage more for an uneven-aged stand structure would aid the forest to reach the desired conditions over time. The structure of the past and most of the proposed treatments, while planned

out as uneven-aged treatments, would have a distinctly different spatial layout than is being planned in this project. Treatments designed in the Rim Country project have identified distinct interspaces of varying sizes with groups of varying sizes as well as randomly spaced trees to aid in forest diversity (horizontal and vertical) while at the same time breaking up areas of continuous canopy to reduce risks to crown fire. Past uneven-aged treatments would have trees more uniformly spaced with more of a closed canopy (moderately closed to closed).

Forest Process

Past thinning treatments resulted in low to moderate stand density index, which is associated with minimum competition between trees, and maximum individual tree growth. This in turn had a beneficial effect of improved forest growth, and reducing the potential for density- and bark beetle-related mortality. Where they occurred, thinning treatments also removed dwarf mistletoe infected trees, reducing the percent of trees infected as well as potentially creating conditions that slowed or inhibited mistletoe spread, even if only for a couple of decades (Conklin and Fairweather 2010). Prescribed fire and low severity wildfire also led to localized reduction of forest density and dwarf mistletoe infection (Conklin and Fairweather 2010). The thinning treatments reduced risks associated with dense forest conditions and improved resilience to the impacts of large-scale disturbance under drier and warmer conditions (Zhang 2019).

Alternatives 2 and 3

Alternative 2 restoration treatments would contribute an additional 991,060 acres toward improving forest health and vegetation diversity/composition, sustaining old forest structure over time, and moving forest structure toward the desired conditions within the cumulative effects area.

Alternative 3 restoration treatments would contribute an additional 528,850 acres toward improving forest health and vegetation diversity/composition, sustaining old forest structure over time, and moving forest structure toward the desired conditions within the cumulative effects area

Prescribed Fire

Prescribed fire is considered to be an integral component to stand treatments and is a necessary complimentary treatment to mechanical treatments to attain and maintain the desired conditions. Without prescribed fires it would be more difficult to maintain desired conditions or reduce unintended results from uncharacteristically high wildland fire at the landscape level. Prescribed fire would be implemented across the project area from a combination of this project as well as other projects such as Cragin Watershed Protection Project and the Haigler Fuels Analysis.

For the analysis period, prescribed fire such as broadcast burns reduced fuels, modified fire behavior, and lowered crown fire risks. The majority of these acres occurred since 2004 and many may require reintroduction of a prescribed fire within the next 5 years in order to maintain the benefits of the prior burn. The proposed acres of mechanical treatment and/or prescribed fire of the Rim Country 4FRI project (991,060 acres in Alternative 2 and 528,850 acres in alternative 3), combined with the reasonably foreseeable treatments proposed (table 28) would reduce uncharacteristically severe fire behavior on approximately 1,100,000 acres in alternative 2 and 700,000 acres in alternative 3 over the next 20 years. The prior treatments should allow prescribed fire-only treatments, with burns within the same stands as this project, to reduce emissions. Cumulatively, the prior treatments and the proposed prescribed fire create some of the best possible outcomes to reduce undesirable fire behavior and/or effects.

Forest Structure

From the 1970s until 1996, treatments were designed primarily to manage for even-aged stand structure. Alternatives 2 and 3 would treat the area to move stands toward an uneven-aged structure where possible. Treatments after 1996 had an uneven-aged silviculture emphasis and those treatments have moved those stands toward their desired conditions at the time of treatment. When added to projects like CC Cragin and Haigler Fuels Analysis structure would be improved under alternative 2 and to a lesser extent under alternative 3. Prior treatments have reduced densities within and outside PFAs, but very little treatment has occurred within Mexican spotted owl protected activity centers and Cores. Stands treated prior to 1996 would be treated within this proposal as the project moves these stands toward an uneven-aged structure and putting them on a trajectory to achieve their Desired Conditions, with alternative 2 treating approximately 462,000 more acres than alternative 3. Cumulatively, alternative 2 improves stand structure more than alternative 3.

Most past treatments in the cumulative effects area left the forest with denser stands when compared to the proposed restoration treatments in this project. Spatially, the prior treatments, until recently, focused on a uniform distribution of trees with only natural canopy gaps and meadows for openings. When added to more recent past treatments the restoration prescriptions in alternatives 2 and 3 would leave a more open forest, post treatment, than was prescribed in past treatments, with distinct interspaces, groups, and regeneration of varying sizes as well as randomly spaced trees across the landscape to enhance structural diversity. Due to fewer acres being treated in alternative 3 the cumulative effects would occur on few acres. Planned interspaces would average between 10 to 90 percent at the stand level from closed forests to open grasslands in both alternatives. The proposed restoration treatments are a departure from past management and have desired conditions for interspaces and groups that would move these stands toward the LMP's desired conditions.

Forest Health

Density related mortality

Stand density is a dominant factor affecting the overall health and vigor of conifer forests in the western United States (SAF 2005) and high stand densities leads to reduced ecosystem resilience (Reynolds et al. 2013).

Prior treatments have used prescriptions, both even-aged and uneven-aged, to reduce stand densities. Table 28 lists some of the treatments that were or will be completed in the analysis area during the analysis period and most all vegetation manipulation treatments were designed to reduce stand densities to some extent. Even with the reduced stand densities some stands were susceptible to the drought period during the early 2000s. This is probably an indicator of stand behavior at these treatment densities in context with climate change. Because of these treatments these stands have moved toward the desired conditions. However, not all were designed as a restoration treatment, especially those implemented earlier in the analysis period. Therefore, these stands may not be moving toward the restoration desired conditions of this project and could be treated again in order to aid in moving them to their desired conditions, or onto a trajectory to achieve the desired conditions.

Proposed treatments in the foreseeable future would be more closely allied with a restoration-based desired condition and prescription such as that in the Rim Country project. The Apache-Sitgreaves and Coconino National Forests Land Management Plans clearly spell out the intent to treat widely across the forest with a restoration desired condition. The foreseeable acreages for projects such as Cragin Watershed Protection Project and the Haigler Fuels Analysis demonstrates this intent. When this is combined with the foreseeable treatments (table 28), Rim Country treatments would move a considerable

portion of the landscape toward a desired condition of reduced stand densities with an open grass/forb/shrub matrix in a heterogeneous landscape. These changes would occur in both alternatives; however, in alternative 3 the movement toward the desired condition would only occur on the treated acres.

Bark beetle related mortality

Bark beetles are normal endemic insects in ponderosa pine and mixed conifer communities and the pine type has evolved with such disturbances (Reynolds et al. 2013). But when conditions are conducive to beetle outbreaks insects can become a strong determining factor in stand structure and composition that can become even more pronounced during and following extended droughts and under dense stand conditions (Reynolds et al. 2013, Negrón 1997). Consult USDA Forest Service (2014) for a history of epidemic bark beetle infestations within the analysis area from the 1950s thru 2014. The current stand structures reflect the occurrences of these epidemic outbreaks.

Prior treatments within the analysis area were completed with a desire to reduce hazardous fuels and reduce stand densities. The drought period from 2000 until now has challenged many stands with bark beetle infestations. The current conditions are still dense in many stands as attested to by their high SDIs. Post 1996 treatments were effective in reducing density related mortality. Even with the reduced densities some stands were susceptible to the drought period during the early 2000s. Rim Country treatments would further restructure stands toward the restoration-based desired condition and when added to the past treatments this should aid in relieving further stresses in both alternatives 2 and 3, but in more stands in alternative 2. Because bark beetles can fly considerable distances and have multiple generations in one season, treatments outside, and adjacent to, the analysis area would have an important influence of beetle activity within the analysis area.

Dwarf mistletoe infection

Activities identified in table 28 treat acres mechanically and with the use of prescribed fire. Many of these treatments had a considerable effect on the distribution, but more importantly, the abundance of dwarf mistletoe. Mitigation strategies for dwarf mistletoe (DM) attempt to reduce stand dwarf mistletoe ratings (DMR). Where dwarf mistletoe is present, silvicultural prescriptions prioritize removal of infected trees (at or above a predetermined infection level). Due to the limited transmissivity of dwarf mistletoe, treatment of stands outside the analysis area do not have as great a potential impact to dwarf mistletoe spread in the analysis area as do stands adjacent to the analysis area. While seeds of the dwarf mistletoe are forcibly ejected, the spread of dwarf mistletoe throughout and between stands is relatively slow (Conklin 2000). However, infection from outside of the analysis area from adjacent stands and into stands within the analysis area is possible, though infections outside the analysis area would have little impact to growth or mortality to the overall analysis area.

Prior treatments within the analysis area would have reduced, but not eliminated, dwarf mistletoe from the treated stands. The dwarf mistletoe infections would continue to slowly intensify. Foreseeable treatments would potentially reduce infection levels further and would benefit the overall analysis area in terms of improved tree growth and vigor and reduced bark beetle risks. Where possible, the Rim Country project would target stands with moderate and severe dwarf mistletoe infections at an appropriate intensity level to lower the infection rating. Infected trees can grow at near the rate of uninfected trees on good sites if individual tree infections remain at or below a dwarf mistletoe rate of 3 (Hoffman 2010). Combined with other treatments in the cumulative effects area such as Cragin Watershed Protection Project and Haigler Fuels Analysis, occurrence of dwarf mistletoe infection severity would move toward desired conditions. However, dwarf mistletoe is a natural component of the ponderosa pine and dry mixed

conifer communities and eradication is neither desirable nor possible, and latent infections (those not visible at the time of treatment) would remain within the stands.

Other Direct and Indirect Effects

Climate change

Risks associated with dense forest conditions would be reduced and resilience to the impacts of large-scale disturbance under drier and warmer conditions would be improved by implementing the treatments proposed under alternatives 2 and 3. Prior treatments would benefit the forest by reducing densities and reducing stresses associated with completion. Treated forest would be more resilient to climate change than untreated forest (Kerhoulas et al. 2013). Within-forest carbon stocks would be temporarily reduced under alternatives 2 and 3, however large-scale stand replacing wildfires such as the Rodeo-Chedeski and Wallow fires that emitted enormous amounts of carbon dioxide would be less likely to occur. Individual tree growth would improve, resulting in larger average trees size and increased carbon storage over time offsetting short term losses of carbon removed through the mechanical thinning. Some of the carbon biomass removed by mechanical thinning would be stored for a considerable period of time in the form of forest products.

Residual Tree Damage

Some damage to residual trees would be expected in alternatives 2 and 3 with the felling, tractor yarding and piling operations associated with mechanical treatments in ponderosa pine. Damage rates should be similar or less than current silviculture practices due to the more open conditions created. Alternative 2 would result in the most potential damage because of the extensive harvesting in overly dense stands. Damage would be minimized through contract administration, on-site inspections, and proper harvest methods. All piling and/or low-severity burning treatments would reduce understory stocking and reduce inter-tree competition as well as stimulate understory vegetation (shrubs, forbs, grasses). Prescribed fire is expected to damage some residual trees and increases short-term risks to low level bark beetle activity.

Fire Ecology

Only a summary of the fire ecology analysis is presented here. The Fire Ecology and Air Quality Specialist report (USDA FS 2022) includes the complete analysis and is incorporated by reference.

Affected Environment

In regard to fire, the Rim Country landscape is a temporal and spatial mosaic made up of a complex mix of cover types (figure 4 and appendix A – Forest Types) and fire regime groups (table 34). The cover types have different fire hazards associated with them throughout the year. The typical climate of the project area includes conditions favorable for frequent early summer fires (Harrington and Sackett 1992), with rainfall minimums occurring in May and June, and some areas averaging less than 0.5 inches during those months. The spring dry season is accompanied by increasing air temperatures, low humidity, and persistent winds, and is broken in early to mid-July with development of almost daily thunderstorms; July and August are the wettest, warmest months. A second dry season occurs in the fall. While the majority of fires in the project area are in the spring dry season, fires have been reported in the fire occurrence dataset in all cover types in every month of the year due to inter-annual variability in weather.

Table 34. Fire regime groups adapted from (Barrett et al. 2010)

Group	Frequency	Severity	Severity Description	Cover types that would be affected by treatments proposed under 4FRI	Acres of FRG within Project Area
I	0 – 35 years	Low to mixed	Stand replacement is less than 25 percent of the dominant overstory vegetation.	Most ponderosa pine, dry mixed conifer, savannas	1,142,310
II	0 – 35 years	High	High severity replaces greater than 75 percent of dominant overstory (grasslands).	Grasslands. Grasses and forbs are the dominant species. Greater than 75 percent of these are likely to be top-killed by fire.	5,483
III	35 - 100 years	Mixed to Low	Generally mixed-severity; may also include low severity fires.	Some mixed conifer, chaparral, some pinyon/juniper, Madrean Pinyon/Oak Woodland.	70,823
IV	35 - 200 years	High	High severity.	Seral aspen, some wet mixed conifer, some aspen	12,296
V	200+ years	High or any severity	Any severity may be included, but mostly replacement severity; may include any severity with this frequency	Some of the Piñon/Juniper, wet mixed conifer, some aspen.	6,386

Background and Historic Conditions

Historically, fire served a critical role in maintaining and sustaining the ecosystems of the Rim Country project area. Prior to euro-American settlement of the region, fires burned frequently and often with low severity across broad areas acting as a driving force in maintaining ecological integrity. However, across the Rim Country landscape, the disruption of Fire Regimes over the last century is largely responsible for the deteriorating health of the ecosystems in northern Arizona (Covington and Moore 1994). In the latter part of the 19th century, unsustainable practices in fire suppression, grazing, and logging began to change the structure and composition of landscapes, making them more homogenized and dense. As a result of the loss of this ecological driver, ecological functions are now impaired across the landscape of northern Arizona (Leopold 1924; Covington and Moore 1994; Heinlein et al. 2005; Rodman et al. 2017).

Fire is a keystone process affecting the ecological functions of fire-adapted forests. As Europeans settled into the area, roads and trails increasingly broke up the continuity of surface fuels and contributed to the reduction of the frequency and size of wildfires (Covington and Moore 1994). Long periods without fire changed the species composition and fuel structure of southwestern ecosystems (Swetnam 1990b; Huffman 2017). There are about 800,000 acres targeted for restoration in Rim Country that historically were maintained by frequent fires.

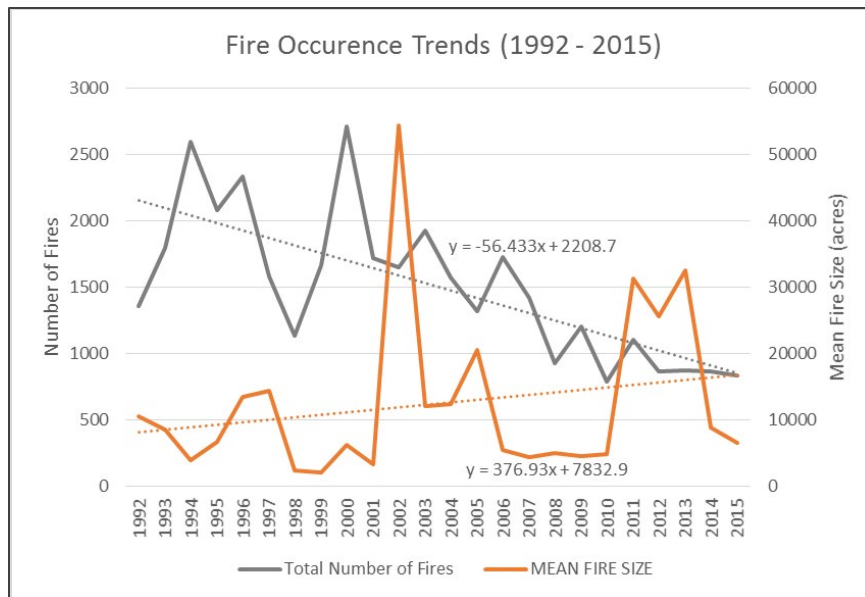


Figure 48. Trends in mean fire size and total number of wildfires from 1992-2015

Contemporary Fire Conditions

Fire Occurrence & Fire Regime

There is little doubt that fires, started by lightning or by Native Americans, were frequent before the arrival of the Europeans and in the early years of settlement. Historically, fires occurred frequently, with return intervals ranging from a few years to a decade or more. These historic fires were typified by low severity. Not until the mid-20th century were a limited number of large-scale stand-replacing fires recorded (Cooper 1960).

While the historic period for this area was characterized by predominantly low and mixed severity fire that served to sustain and promote ecological integrity, there has been a concerning shift in the contemporary period to large fires with patches of high-severity fire effects. This observed shift in fire trends has led to an increase of what is commonly referred to as “uncharacteristic fire.” Uncharacteristic fire refers to fire that produces a higher percentage of high-severity effects than ecologically appropriate in the primary fire adapted ecosystems prevalent in the Rim Country project area. This has been expressed as a shift to higher percentages and larger patches of high-severity fire in Ecological Response Units that historically supported predominantly low and mixed severity fire.

The total number of fires reported in and adjacent to the project area has decreased over the last century, while the average size has increased (figure 48). While fire size is certainly an indicator of the trends in wildfire, it is primarily those areas that burn with uncharacteristically high severity that are of concern.

While the majority of acres burned most years in wildfires continue to be low severity, the total number of acres burning with high severity is much larger than historic data indicates was typical of ponderosa pine in the southwest (Weaver 1951; Covington 1994; Swetnam and Betancourt 1998; Westerling et al. 2006). Of the annual acres burned by large fires since 1992, about 73 percent burned at low severity on average, and 27 percent burned at moderate to high severity. However, the 2002 Rodeo-Chediski Fire (see discussion on page 29 of the Fire Ecology Specialist report), which burned with a much higher percentage of moderate and high severity, serves as an outlier to this pattern. Overall, the annual acres burned by

large fires has increased since 1992 (figure 49), while the proportion of acres burned in each severity class has remained about the same (figure 50). If these patterns continue into the near future (10 years), the total acres of high severity fire is expected to increase proportional to fire size increases.

Fire itself is not inherently bad, and in the right form is essential to the proper ecological function of the Rim Country landscape. In understanding the ecology of these ecological systems, it is important to differentiate between low-moderate severity fire, which can be beneficial, and moderate-high severity fire which, in large patches, can be detrimental to ecological integrity.

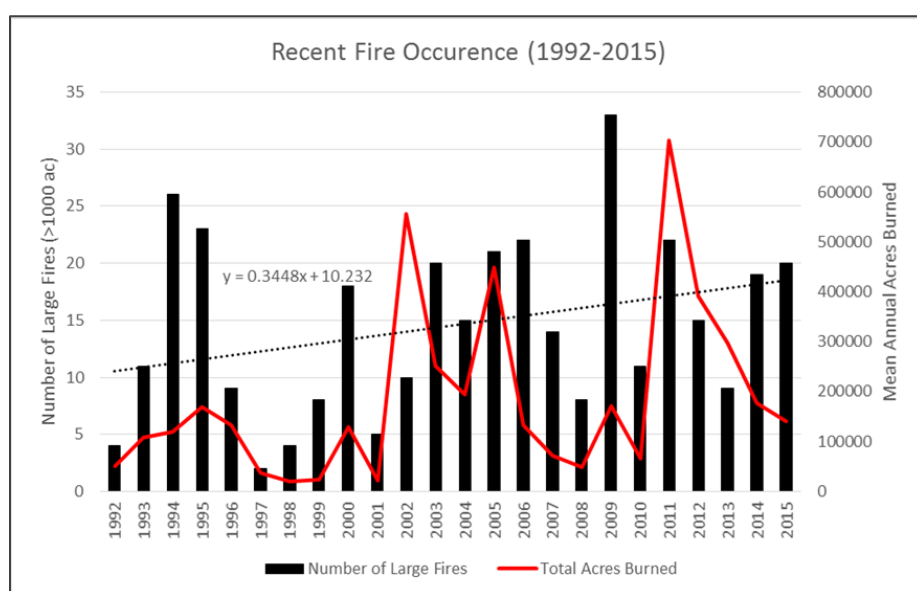


Figure 49. Trends in the number of large fires (greater than 1,000 acres) and total acres burned from 1992-2005 within the Arizona/New Mexico Mountains Ecoregion

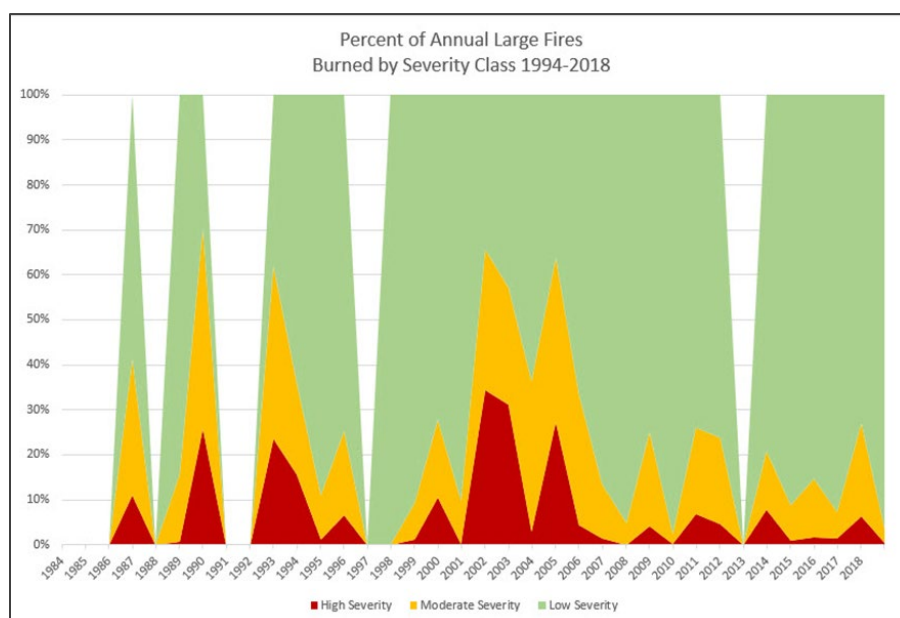


Figure 50. Percent of annual large fires burned by severity class



Figure 51. Conditions in dry mixed conifer in the project area that could easily support high-severity fire



Figure 52. Locust dominated area in the Sierra Ancha where the Coon Creek Fire produced high-severity effects in 2000

Areas of high-severity fire can have detrimental impacts that extend far from the actual fire perimeter. Many of the areas that burned under high severity have been slow to regenerate trees and in places are now dominated by herbaceous and shrubby vegetation such as New Mexican Locust (*Robinia neomexicana*) (figure 52). High severity fire, especially over large areas also leaves surface soil layers vulnerable to erosion. Additionally, debris flows and floods associated with severely burned areas may have severe, long term effects on areas downstream, downslope, and adjacent to the burned area.

Current forest conditions inhibit the survival and recruitment of large trees by fueling increasingly extensive high-severity fires. These fires have the potential to alter the recovery of post-burn vegetation,

creating entirely different communities than those existing before such events (Savage and Mast 2005; Strom and Fulé 2007; Kuenzi et al. 2008). Figure 51 shows dense forest conditions (numerous trees with dense, contiguous canopy fuels) that occur within the project area that would support high-severity fire. Even without crown fire, a surface fire burning through this area could do enough damage to trees to cause widespread mortality (Van Wagner 1973).

Fire Return Interval (FRI)

Fire Return Interval can be used as a coarse indicator of how departed an area is in regard to the fire regime. The fire return interval calculated for this analysis does not take into account seasonality, severity, size, spatial complexity, or other important characteristics of a fire regime. However, particularly when combined with vegetation or forest types, and severity, it is a useful indicator for evaluating how far an area has departed from a sustainable fire regime.

Fire Return Interval is a component of the fire history of an area. The Mogollon Rim, and the Sierra Ancha areas have a high density of ignitions, both lightning and human. In the past 31 (1987–2017) years, 850,215 acres of the 1,238,658-acre project area burned, for a mean annual acres burned of 27,426 acres. In addition to wildfire, 242,028 acres of prescribed fire have occurred in the project area from 1995–2018 for another 10,084 acres per year. Prescribed fire is often focused on areas strategic to values at risk, and therefore is concentrated on the landscape, rather than distributed throughout (figure 53).

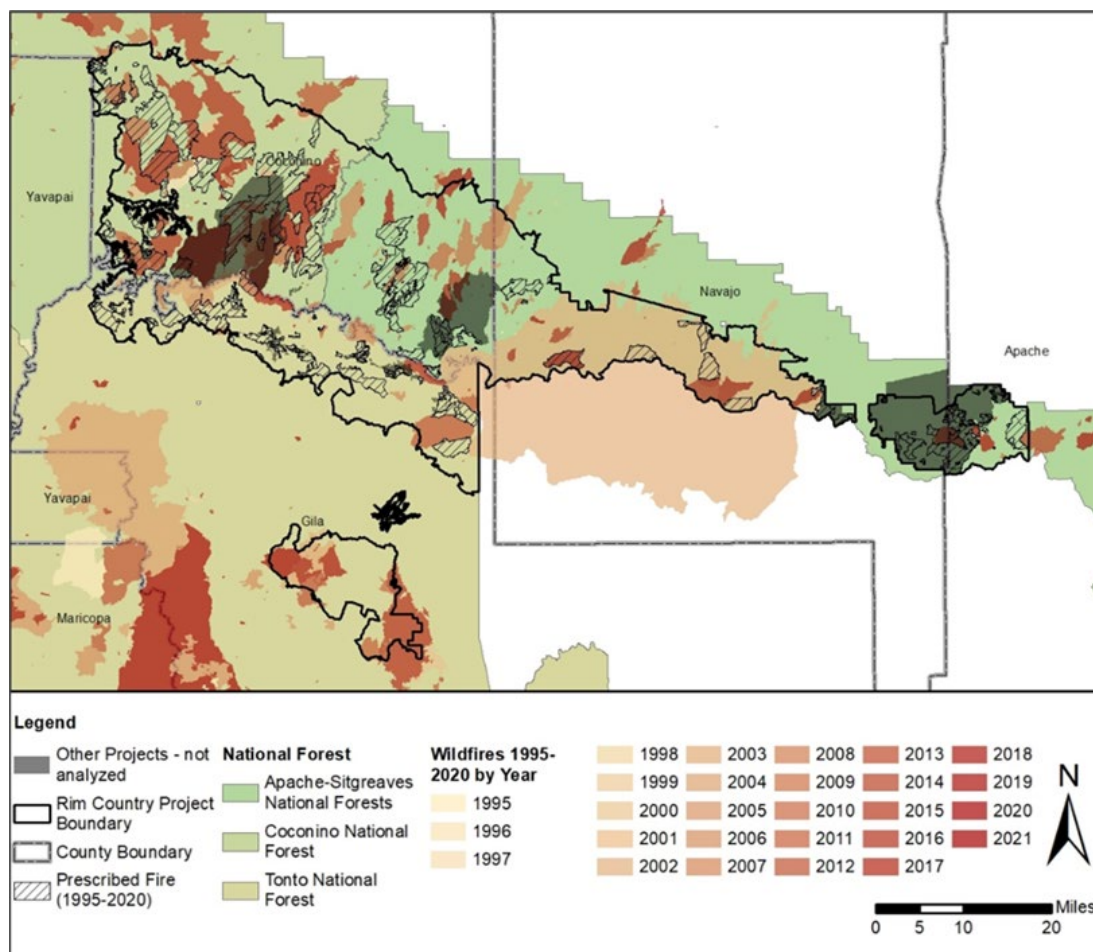


Figure 53. Location of recent wildfire (1987–2020) and prescribed fire (1995–2020) within the project area

Taken together, the mean fire return interval for the entire project area is 33 years. While this represents a positive reintroduction of ecologically appropriate fire to the landscape, it still represents less frequent fire than is appropriate for these systems. In order to restore ecological balance in these systems, more frequent fire is needed across the landscape.

For Ponderosa Pine forest types, the recent fire return interval is 38 years (table 35). This is almost double the desired maximum average for maintenance burning in ponderosa pine on the Mogollon Rim. The fire return interval is 59 years for Ponderosa Pine-Evergreen Oak, 65 years for dry mixed conifer, and 113 for grasslands in the project area. These fire return intervals represent an average that includes areas that have burned much more frequently and areas that have burned at a much longer frequency. These higher than natural fire return intervals have contributed to the degree of departure from historic conditions that puts over 51 percent of the area proposed for treatment area at risk of moderate to high-severity fire effects based on recent severity proportions.

Table 35. Vegetation cover types targeted for restoration, and their desired and current fire regimes across the project area

Cover type	Acres of each cover type	FRI Desired (average)	FRI Current+	High Severity Fire: Desired %	High Severity Fire: Recently Burned w/ High Severity++	High Severity Fire: Potential to Burn with-High Severity Effects	Average Annual Acres burned +	Average annual acres needed to burn to meet desired conditions
Ponderosa Pine (montane)	642,198	2 - 22 (12)	38	< 20 (<5% active crown fire)	27% High	20%	14,495	~45,000
Ponderosa Pine – Evergreen Oak**	148,332	1 - 60 (7)	59	< 25 (with <10% active crown fire)	29% High	29%	2,477	~20,000
Mixed Conifer – Frequent Fire	52,723	2 - 61 (15)	65	< 20 (with <7% active crown fire)	19% High	50%	743	~3,200
Aspen	1,416	5 - 150	739	N/A	N/A	5%	2	~15
Grasslands	15,946	2 -40 (12)	113	<10%	12% High	2%	379	3,600
Riparian	13,050	Related to, but not the same as, adjacent cover types.	Related to, but not the same as, adjacent cover types.	Related to, but not the same as, adjacent cover types.	Related to, but not the same as, adjacent cover types.	Related to, but not the same as, adjacent cover types.	N/A	N/A

+ Average calculated across all stands with that cover type for the past 30 years (1987 – 2017) for wildfire plus the past 24 years (1995 – 2018) for prescribed fire

++Data from Monitoring Trends in Burn Severity from 1992 – 2015

**Evergreen Shrub Subclass included in acres, but not in desired condition surface wind speed, which, in turn, affects surface fire intensity and rate of spread. Across the project area, canopies have become much more closed, resulting in elevated potential for crown fire and decreased surface vegetation.

+ Based on modeled fire behavior of active crown fire under extreme fire weather conditions

Surface Fuels and Canopy Characteristics

(Section added from DEIS fire ecology specialist report for consistency)

The ability of a forest to maintain its adapted resilience to fire depends, in part, on how close it is to threshold conditions that would support a fire of an intensity and severity to which it is not adapted. In frequent fire systems in which the fire regime has been interrupted, those conditions generally result from excessive tree densities and surface and canopy fuels.

Canopy characteristics

(Section added from DEIS fire ecology specialist report for consistency)

The specific characteristics that determine the likelihood of crown fire initiation are tree densities (canopy cover, canopy base height, canopy bulk density, and canopy height) and surface fuels accumulations. While there are no specific desired conditions for these canopy characteristics, they are important variables to be addressed in proposed treatments. Tree densities affects the ability of fire to move from the canopy of one tree to the canopy of another, thus is a significant component in differentiating the potential for a stand to transition from passive to active crown fire. Additionally, tree canopies shade the surface, affecting surface vegetation which defines fuel structures and affects fuel moisture.

Canopy cover also affects surface wind speed, which, in turn, affects surface fire intensity and rate of spread. Across the project area, tree canopies have become much more closed, resulting in elevated potential for crown fire and decreased surface vegetation. Canopy base height is the lowest height of the part of the tree canopy which could support sufficient flames to propagate fire up into the rest of the crown (Scott and Reinhardt 2005). Canopy base height is a critical factor in crown fire initiation. In the last century, ladder fuels have effectively lowered the functional canopy base height as small trees and shrubs now provide ‘ladders’ by which flames can climb into tree canopies. Canopy bulk density is the mass per volume of the crown of a tree. Denser canopies have more fuel, and can burn with a higher intensity (longer flame lengths). They will ignite more easily than sparser canopies if fire reaches them and it is the primary component determining conditional crown fire. Tree canopy height is the height of the top of the canopy of a forest. Its primary effect on fire behavior is spotting potential. Taller trees are likely to spot further than shorter trees if their crowns are burning.

Surface fuels

Historically, fine surface fuel loads were made up primarily of herbaceous material and fire burning though it would move relatively quickly, with a short residence time and a high rate of consumption. Repeated fires would consume coarse woody debris surface fuels a little at a time, allowing natural accumulation from branches or snags to maintain equilibrium based mostly on fire frequency (Covington and Sackett 1984).

Currently, across much of the project area, surface fuels are dominated by needle litter and duff that has accumulated over years to decades and is more closely packed than herbaceous fuel. Fire burning through these fuels will have a longer residence time, or longer burning time, than in herbaceous fuels, and the lower layers may smolder for extended periods, transferring more heat to the soil, roots, and boles of trees (Lutes et al. 2009, Valette et al. 1994; Sackett and Haase 1996). Litter and duff cones have accumulated around the base of many large and/or old trees in the project area and are likely to cause, or contribute to, undesirable mortality (Egan 2011). Prescribed fire can produce fire behavior that is less likely to cause lethal damage.

These fuel layers cannot be practically addressed by mechanical means across the entire area proposed for treatment under any of the action alternatives, even if it was ecologically sound to do so. Mechanical treatments may move duff and litter around, creating temporary discontinuities in the surface litter layer, but the biomass remains on site.

(Paragraph added from fire ecology specialist report for consistency, highlight indicates new information)
Desired conditions for total surface fuel loadings are less than 27 tons per acre in Ponderosa Pine vegetation types and less than 30 tons per acre in Dry Mixed Conifer. Currently, surface fuel loadings exceed recommended levels for 60,023 acres of Ponderosa Pine and 12,262 acres of Dry Mixed Conifer vegetation types (figure 54).

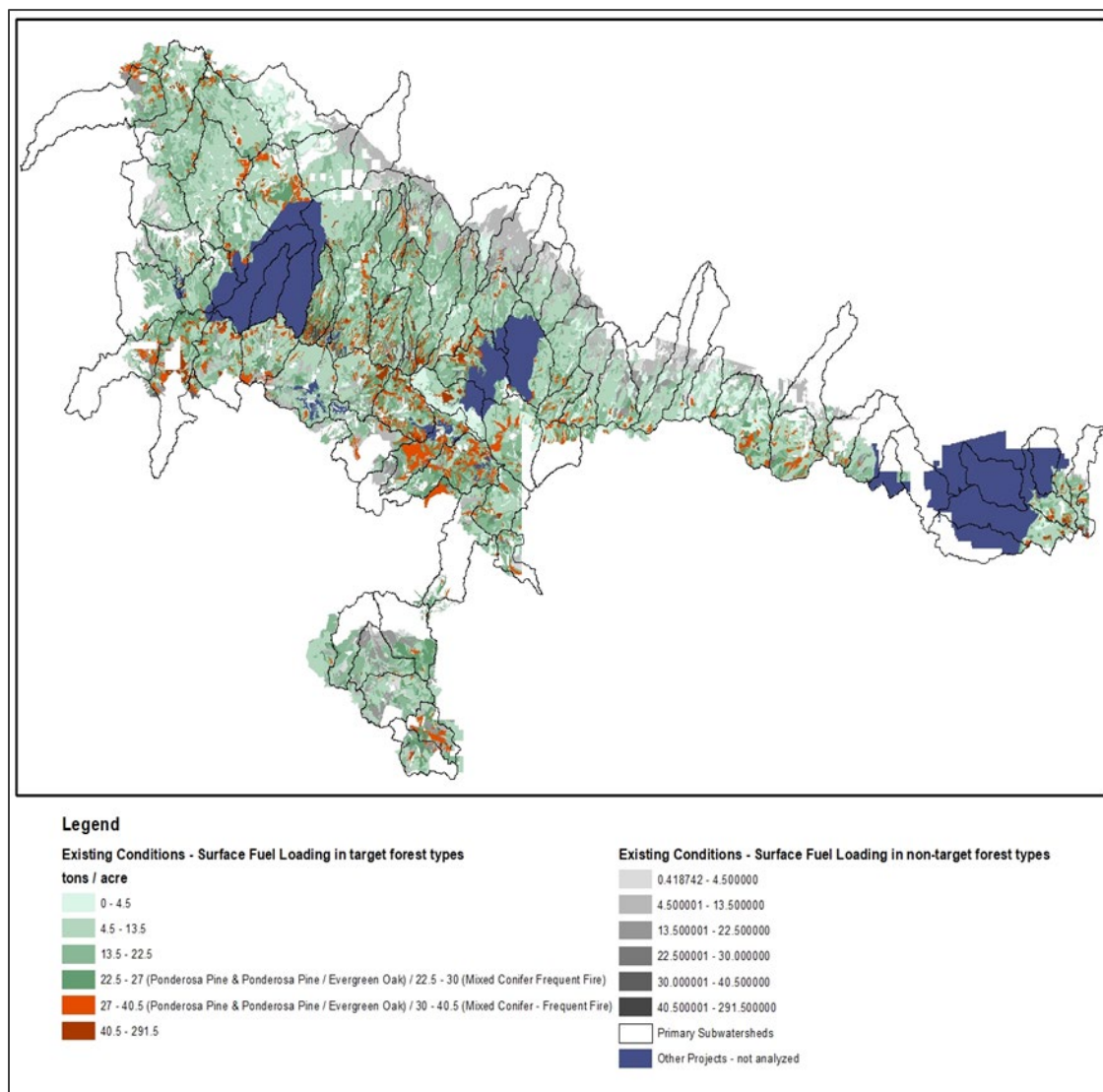


Figure 54. Total surface fuel loadings in tons per acre. Areas in orange and red exceed recommended levels.

Wildfire Management

Initially, and through most of the 20th century, wildfires burning in frequent fire regimes in the Southwest were relatively easy to suppress. Fuels were mostly light and flashy, and forests were open with high

canopy base heights, and suppression was a common response. Many areas were increasingly overgrazed to the point where some areas could not carry fire at all and/or fires were easy to suppress. Settlers saw fire as a threat, and actively suppressed it whenever they could. The subsequent accumulation of fuel, through litter-fall, logging debris, and development of ladder fuels that can initiate crown fire (Covington and Moore 1994) made fire suppression more difficult. As wildfires became more difficult to suppress, firefighting technology, tactics, strategies, equipment and support improved dramatically, allowing suppression forces to succeed in suppressing all but the most intense and extreme fires.

(Paragraph added from fire ecology specialist report for consistency, highlight indicates updated text)

Currently there are many conditions that prevent management of wildfires in a manner that does not result in the loss of life, property or ecosystem function. Not all wildfires are currently burning within natural fire regimes. Recent economic and ecological damaging wildfires in the area include the Rodeo-Chediski, Whitewater Baldy, and Wallow Fires. The Rodeo-Chediski Fire destroyed 426 residences. The recent Tinder Fire, which burned within the project area, consumed 41 homes in 2018. The Dude Fire of 1990 claimed 6 lives and 63 homes. Schultz and Highline Fires both resulted in post wildfire debris flows that resulted in deaths.

Wildland Urban Interface

The wildland urban interface is the area where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels ((National Wildfire Coordinating Group) 2018). It is that portion of the landscape where structures and vegetation are sufficiently close that a wildland fire could spread to structures, or a structure fire could ignite vegetation. Many wildland urban interface areas are scattered across the project area, though areas of the greatest concern are relatively focused around towns or along travelways. For this analysis, the wildland urban interface is defined by a 0.5-mile buffer surrounding non-Forest Service lands where structures are present (figure 55). Other critical infrastructure (Transmission Lines and Communication sites) and high value Forest Service Infrastructure (Buildings and Recreation Sites) were also included within the wildland urban interface for this project.

(Paragraph added from fire ecology specialist report for consistency, highlight indicates updated text)

Prescribed fire is often focused on areas strategic to wildland urban interface, and many prescribed burns next to WUIs have been implemented in the past 24 years. While this has lowered fire hazard within this area relative to the general landscape, desired conditions are not fully met, where 26 percent to 31 percent of the lands surrounding the wildland urban interface have potential for active crown fire and 34 percent to 38 percent are in the moderate to very high fire hazard index category (table 36).

Table 36. Existing conditions metrics for the wildland urban interface (WUI) classes (added for consistency, highlight indicates updated text in the fire ecology specialist report)

Existing Conditions	Fire Hazard Index				Fire Type	
WUI Class	Total Acres	Very Low - Low	Moderate	High	Extreme	Passive & Active Crown Fire
Communication Sites	13,333	67%	13%	18%	2%	75%
FS Buildings & Rec Residences	10,548	62%	11%	21%	5%	76%
High Value Rec Sites	5,581	64%	9%	21%	7%	83%
Non FS Land with Structures	144,691	66%	16%	16%	3%	70%
Transmission Lines	28,885	66%	16%	15%	3%	65%

FS – Forest Service

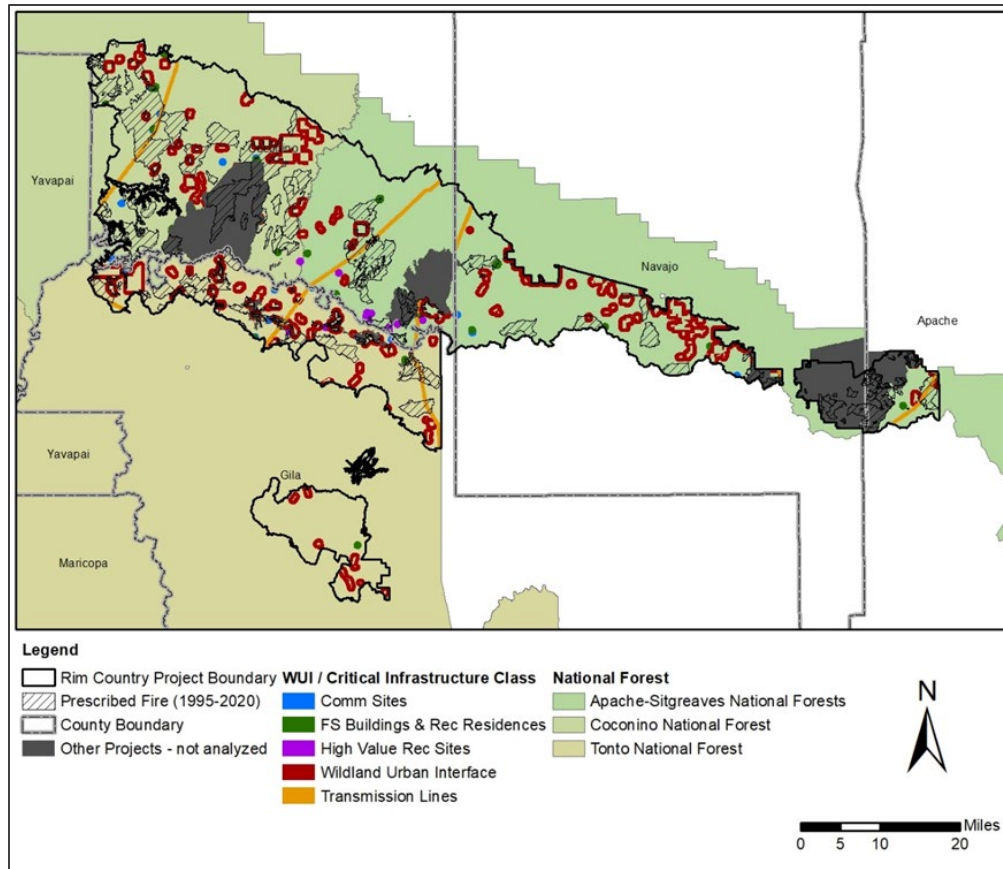


Figure 55. Wildland urban interface, as defined and mapped by the project. Recent prescribed fires are shown by hashed polygons.

Large and/or Old Trees

Large and/or old trees in the project area increase structural diversity, improving habitat for birds, insects, and other animals. Old trees have greater genetic diversity than even-aged groups of young trees and provide forests a better chance of adapting to changing climate conditions and other environmental stressors (Minard 2002). Large and/or old trees within the project area are threatened by the increasing size and severity of wildfires.

Crown damage is an important factor in the mortality of old trees for which the death is attributed to fire (Fowler and Sieg 2004; Haase and Sackett 2008; Hood 2010b). The proximity of dense young trees and ladder fuels is problematic because it is so widespread. In the transitional pine areas various species of juniper and oak are components of the forest, often centuries old. The overtopping of these trees by ponderosa pine allows a buildup of needles in the crotches and forks. This can lead to greater mortality and/or damage to very old trees when highly flammable needle accumulations burn than would occur without the needle accumulations.

(Paragraph added from the DEIS fire ecology specialist report for consistency) Currently, across much of the project area, fuel loads of all kinds in the immediate vicinity of large and/or old trees are such that mortality would be high in the event of a wildfire burning under undesirable conditions. In the historic period, mortality in large trees was mostly caused by lightning fires, dwarf mistletoe, bark beetles, windthrow, or senescence (Cooper 1960). Since the exact location of large/old trees is unknown the analysis of this value at risk is qualitative and comparisons will be made as such.

Vegetation Cover Types

Table 37. Desired and Existing Conditions for vegetation cover types for each metric. (Added for consistency, highlight indicates updated text in the Fire Ecology Specialist report)

Vegetation Cover Type (VCT)	Total Acres	Fire Type				Fire Hazard Index			Total Surface Fuel Loading		
		All Crown Fire		Active Crown Fire		Moderate	High	Extreme	Desired (tons / ac)	Meets	Exceeds
		Desired % of VCT	Existing %	Desired %	Existing %	Existing %	Existing %	Existing %		Existing (ac)	Existing (ac)
Ponderosa Pine	642,198	< 20%	72%	< 5%	20%	11%	11%	4%	< 27	597,884	44,315
Ponderosa Pine Evergreen Oak	148,332	< 25%	82%	< 10%	29%	30%	24%	4%	< 27	132,623	15,709
Mixed Conifer – Frequent Fire	55,723	< 20%	75%	< 7	50%	18%	27%	24%	< 30	40,461	12,262
Mixed Conifer – With Aspen	4,739	NA	74%	NA	70%	7%	30%	34	NA	NA	NA
Aspen	1,416	NA	6%	NA	5%	1%	4%	3%	NA	NA	NA
Pinyon Juniper	135,062	NA	71%	NA	65%	33%	26%	2%	NA	NA	NA
Madrean Pinyon Oak	23,056	NA	85%	NA	79%	32%	42%	6%	NA	NA	NA
Grasslands	15,946	< 3%	15%	< 1%	2%	1%	0%	0%	NA	NA	NA
Riparian Areas	13,050	NA	44%	NA	17%	11%	11%	4%	NA	NA	NA

Ponderosa Pine (Montane)

This cover type includes all ponderosa pine other than the ponderosa pine/evergreen oak and transitional pine described in the next section. There are about 543,058 acres of this kind of ponderosa pine forest within the area being considered for restoration treatments.

(Paragraph added from the DEIS fire ecology specialist report for consistency) Existing conditions, as modeled under extreme conditions, indicate potential for 72 percent this forested cover type to burn with crown fire. Of that, a projected 21 percent would be active crown fire (table 37). About 11,125 acres (2 percent) of the montane ponderosa pine is in the “very high” category of the Fire Hazard Index, and another 116,820 acres are in the moderate to high category. In those areas, fire effects could produce irreversible detrimental effects when topsoil is burned or eroded, changing site potential for decades.

Fire Ecology

Ponderosa pine forests are widespread in the Southwest occurring at elevations ranging from 6,000 to 7,500 feet on soils from igneous, metamorphic, and sedimentary parent materials with good aeration and drainage, and across elevational and moisture gradients. The dominant species is Ponderosa pine (*Pinus ponderosa* var. *scopulorum*). Other trees, such as Gambel oak (*Quercus gambelii*), pinyon pine (*Pinus edulis*), and juniper (*Juniperus* spp.) may be present. There is sometimes a shrubby understory mixed with grasses and forbs, although this type sometimes occurs as savannah with extensive grasslands interspersed between widely spaced clumps or individual trees. Canopy cover in the savanna areas is between 10 and 30 percent.

Historically, once fires ignited in ponderosa pine forests, they could burn until extinguished by rain, or until they ran out of fuel, which typically occurred when they reached an area that had recently burned. Fires could burn for months and cover thousands of acres (Swetnam and Betancourt 1990; Swetnam and Baison 1996; Swetnam and Betancourt 1998). Effects from these long burning fires would vary as conditions changed over the weeks or months they burned. As a result, most ponderosa pine in the southwest burned every 2 to 22 years as mostly low-severity, often area-wide fires (Weaver 1951; Cooper 1960; Deterich 1980; Swetnam et al. 1990; Swetnam and Baison 1996; Covington et al. 1997a; Fulé et al. 1997; Heinlein et al. 2005; Kaib 2011).

History

Although the popular early descriptions of the ponderosa pine forest call attention to the park-like stands, there are some descriptions that refer to areas with dense cover (Woolsey 1911). An accurate picture of the pre-settlement ponderosa pine forest would probably describe a mosaic of mostly open, grass savanna and clumps of large, yellow-bark ponderosa pine and open forest with an occasional dense patches or stringers of small, blackjack pines (young ponderosa pine).

Extensive stand-replacing fires are unreported in the documentary records prior to circa 1950 (Cooper 1960; Allen et al. 2002a). Ponderosa pine does not sprout, so crown fire generally produces 100 percent mortality. There are few data available to indicate how much high-severity fire was typical across the ponderosa pine in northern Arizona, but simulations suggest that presettlement forest structure would have supported very little crown fire, passive or active (Roccaforte et al. 2008, Covington 2001).

(Paragraph added from fire ecology specialist report for consistency, highlight indicates updated text) Historically, passive crown fire produced only small patches of high-severity effects. Extrapolating results from Roccaforte et al. (2008) to those conditions used for modeling Rim Country, patches of high severity, mostly in the form of passive crown fire, would generally have been less than 50 acres in size under those conditions modeled for Rim Country. These patches would occur in areas with windthrow, disease/insect infestation, area ecotones between ponderosa pine and mixed conifer or PJ, or other site

specific situations that would allow crown fire initiation and spread. A number of papers have been published challenging the assertion that high-severity fire was historically rare in the dry forest systems prevalent in the Rim Country project area (Baker and Ehle 2001; Baker et al. 2007; Williams and Baker 2012, 2014; Baker 2015). However, Fulé et al. (2012) concluded that, “the preponderance of scientific evidence indicates that conservation of dry forest ecosystems in the western United States and their ecological, social and economic value is not consistent with a present-day disturbance regime of large, high-severity fires, especially under changing climate”.

Ponderosa Pine – Evergreen Oak & Transitional pine (PPEO)

The ponderosa pine/evergreen oak (PPEO) cover type in this analysis includes vegetative associations which have been referred to by various classifications and names, including transitional pine, Arizona highlands, Ponderosa Pine/Evergreen Oak ecological response unit, Mogollon highlands, various Madrean fringe types (Fleischner et al. 2017; Wahlberg et al. 2017 (in draft); Huffman et al. 2018). To be consistent, this analysis will use the broadest classification, ‘Ponderosa Pine/Evergreen Oak’ (PPEO) to refer to this broad ecosystem type, with more detailed discussion as needed to include unique characteristics.

It is well understood that 20th century fire exclusion in montane ponderosa pine forests has led to substantial increases in tree establishment and associated changes in ecological function (Covington and Moore 1994; Fulé et al. 1997; Moore et al. 1999; Savage and Mast 2005; Strom and Fulé 2007). Much less is known about historical changes associated with modern land use in the PPEO. It appears that cover of long-lived sprouting shrubs has increased in many transitional ponderosa pine forests as a result of fire exclusion (Huffman et al. 2020).

(Paragraph added from fire ecology specialist report for consistency) Long-term fire suppression in this type, has created conditions where large areas are highly departed from historic conditions and have lost ecological integrity. Typically, these changes include in-filling of the canopy gaps, increased density of tree groups; reduced composition, density and vigor of the herbaceous understory plants. Other significant changes resultant from fire exclusion are increased homogeneity of the shrub structural stages on the landscape, facilitating larger patch sizes of high-severity fire effects. Currently, many of these sites are closed-canopy forests, capable of supporting active crown fire (Wahlberg et al. 2017 (in draft)).

(Paragraph added from fire ecology specialist report for consistency) The lack of fire has allowed sprouting shrub species to become established underneath ponderosa pine, more so in the Evergreen Shrub Subclass. It is patchy, with areas of mostly chaparral-like vegetation interspersed with areas of ponderosa pine cover. Historically, the patchiness would be maintained by high-severity fire in areas where there is less ponderosa pine, and more even-aged stands with low to mixed severity fire where there are ponderosa pine needles to facilitate the more frequent fire. The effects of fire suppression are decreased herbaceous surface cover and diversity, and the associated fire behavior producing increased severity in both the PPEO and the Shrub Subtype. This is conducive to fewer pines and more sprouting shrubs. Most of the Shrub Subclass occurs at the lower elevations of the ponderosa pine, and/or on drier, hotter areas. There are no spatial data available for the inclusions of what could be naturally occurring shrub patches, so these areas were all delineated as PPEO.

Under modeled conditions, there is potential for 69 percent of the PPEO to support crown fire; 36 percent of that would be active crown fire (table 37). Almost 40,000 acres (25 percent) of the PPEO is classified as being at ‘high’ or ‘greatest’ need for treatment. In these areas, type conversion to a shrub system is a high probability because of the vigorous sprouting response of various shrubs to being top-killed, and the difficulty of ponderosa seedlings to thrive with that competition.

Fire Ecology

(Section added from DEIS fire ecology specialist report for consistency)

Research in other areas pine/shrub systems found that moderate intensity frequent fires favor ponderosa pine forest while fires that are less frequent but greater severity favor resprouting shrubs. This poses a challenge for management and for proposed restoration treatments.

PPEO forests differ from montane ponderosa pine by site potential, typically favoring high shrub cover, and by higher fire severity, and more even-aged conditions characteristic of mixed-severity fire regimes. Some high-density evergreen shrub patches exhibit infrequent, high-severity fire (fire regime IV; stand replacement at 35–200 years). Larger areas where this pattern was persistent are likely to be identified as Interior Chaparral.

PPEO averages greater fire severity than the montane ponderosa pine forests above the Mogollon Rim, and greater patchiness with less horizontal uniformity and more even-aged conditions. Site potential, fire history, and the importance of perennial grasses versus shrubs in the understory vary, affecting forest structure and the disturbance regime (Wahlberg et al. 2017 (in draft)). Understory shrubs include manzanita (*Arctostaphylos* sp.), turbinella oak (*Quercus turbinella*), skunkbush sumac (*Rhus trilobata*), and mountain mahogany (*Cercocarpus montanus*).

History

(Section added from DEIS fire ecology specialist report for consistency)

It is well understood that 20th century fire exclusion in ponderosa pine forests has led to substantial increases in tree establishment and associated changes in ecological function (Covington and Moore 1994; Fulé et al. 1997; Moore et al. 1999; Savage and Mast 2005; Strom and Fulé 2007). Much less is known about historical changes associated with modern land use in the PPEO. Some species in the PPEO are often growing at their environmental limits and thus can be under high levels of stress within ecotones, thus these zones where communities intergrade are often dynamic and fluctuate in composition over relatively small spatial and temporal scales. It appears that cover of long-lived sprouting shrubs has increased in many transitional ponderosa pine forests as a result of fire exclusion (Huffman et al. 2018).

Historical fire regimes in pine forest communities co-occurring within interior chaparral and Madrean evergreen woodland appear to have been characterized by frequent, low-severity surface fires similar to those widely reported for montane ponderosa pine forests of the Southwest. Frequent fires likely kept forests in open structural conditions and limited establishment and regeneration of sprouting woody species. As was prevalent in other southwestern ecosystems, unregulated livestock grazing in the late 19th and early 20th centuries apparently reduced abundance of herbaceous plants in ecotone communities (such as in both ponderosa pine forests and chaparral shrublands), and interrupted fire regimes. Intensive harvesting of ponderosa pine for mining materials in the mid-1800s undoubtedly contributed to later shifts in forest structure at some sites. Fire regime interruption in the Southwest appears to have allowed shrubs as well as young trees to increase in abundance within transitional pine forests. Similarly, less frequent fire in adjacent shrublands allowed ponderosa pine trees to establish and expand into these communities. Active fire suppression beginning in the mid-1900s likely exacerbated structural shifts of both pine forests and shrublands. The ultimate effect of these anthropogenic influences has been to encourage broader, more complex ecotones, with ponderosa pine trees found overtopping shrubs on both historical forest sites as well as historical shrubland sites. Additionally, research indicates that fire exclusion due to historical intensive livestock grazing and tree harvesting has led to a broadening of ecotone boundaries, with shrubs increasing within pine forests as well as coniferous trees expanding into chaparral and evergreen woodlands (Huffman et al. 2018).

Mixed Conifer

Mixed Conifer includes a wide range of vegetation types and fire regimes. Mixed conifer has been classified into warm/dry, or cool/moist (Romme et al. 2009; Korb et al. 2013; Wahlberg et al. 2017 (in draft)), which can also be distinguished by their natural fire regimes. In this analysis, mixed conifer will be referred to as WMC (Mixed Conifer with Aspen, or Wet Mixed Conifer) or DMC (Mixed Conifer - Frequent Fire, or Dry Mixed Conifer).

Historically, mixed conifer in the Southwest had highly diverse composition and structure. This diversity was largely driven by topography, with the scale of the mosaic of cover types dependent on the scale of topographic variation. Ridgetops and low elevation sites were (and largely still are) characterized by open stands dominated by ponderosa pine and had frequent surface fires. South- and west-facing slopes likely were similar, but were less open and had less ponderosa and more Douglas-fir, aspen and white fir. These stands likely also were characterized by frequent surface fires. North- and east-facing slopes were likely more dense and had still less ponderosa and more white fir, as well as Engelmann spruce and subalpine fir, especially at higher elevations.

Mixed Conifer with Frequent Fire (Dry Mixed Conifer)

Dry Mixed Conifer (DMC) covers approximately 63,000 acres within the area proposed for treatment in Rim Country. It generally occurs at elevations between 6,000 and 10,000 feet, with some variability depending on aspect. DMC is generally situated between ponderosa pine or pinyon-juniper woodlands below and wetter mixed conifer or spruce-fir forests above. Historically, DMC was dominated by ponderosa pine (*Pinus ponderosa* var. *scopulorum*) in an open forest structure (Reynolds et al. 2013; Rodman et al. 2016; Huffman et al. 2018), with minor occurrence of aspen (*Populus tremuloides*), Douglas-fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), and Southwestern white pine (*Pinus strobiformis*).

(Paragraph added from DEIS fire ecology specialist report for consistency) On contemporary landscapes, more shade tolerant conifers, such as Douglas-fir, white fir, and blue spruce (*Picea pungens*), tend to increase in cover in late succession, contrary to conditions under the characteristic fire regime. Historically, these species could have achieved dominance in localized settings where aspect, soils, and other factors limited the spread of surface fire, but this would not have been widespread. Much of this type is currently dominated by closed structure and climax species as a result of a disrupted fire regime (Swetnam and Baisan 1996; Huffman et al. 2015; Rodman et al. 2016; Wahlberg et al. 2017 (in draft)).

(Paragraph added from DEIS fire ecology specialist report for consistency) Modeled conditions show that, currently, there is potential for about 37,400 acres (77 percent) of DMC to burn with crown fire, of which about 26,156 acres (54 percent) would be active crown fire. About 20,000 acres (43 percent) of the mixed conifer has a 'high' or 'greatest' need for treatment.

Fire Ecology

Historical fire regimes were probably similar to those widely reported for montane ponderosa forests of the Southwest. Frequent surface fires likely kept forests in open structural conditions and limited the abundance of woody understory species. Available evidence in DMC forests suggests that high-severity patches would have generally been less than 60 acres, and typically less than an acre with the larger patches being less common (Huffman et al. 2015; Yocom Kent et al. 2015).

History

The historical fire regime on this landscape was one of high frequency, low-severity fires (Huffman et al. 2015). This would have supported a finer grained pattern of vegetation than is currently present. Current conditions show a coarser pattern that would be more consistent with a less frequent, mixed to high-

severity fire regime, increasing the susceptibility to stand-replacing fire, even where such regimes were uncommon historically (Abella and Springer 2014; Rodman et al. 2016). Fire and drought tolerance have decreased since pre-settlement times, driven largely by increases in the relative importance of white fir (*Abies concolor*) and southwestern white pine (*Pinus strobiformis*), but also shifts from shade intolerant species to shade tolerant species (Strahan et al. 2016).

Fire Type

(Section added from DEIS fire ecology specialist report for consistency, highlight indicates new information)

Currently, under extreme weather, 73 percent of the Rim Country project area is expected to burn with crown fire, and 30 percent of that is expected to be active. This assumes a wind of 20 mph, which regularly occurs during the fire season (figure 56) but represents extreme fire weather under which suppression tactics are unlikely to be highly successful.

Post wildfire watershed effects increase with the percent of the watershed that burns at moderate to high-severity fire (Cannon 2011; Neary 2011). Currently, 44 watersheds have expected active crown fire under extreme weather conditions for over 30 percent of the watershed, which would result in high-severity effects (figure 57). Thirteen watersheds have over 50 percent of the watershed expected to burn with active crown fire. Watersheds 7 (Reynolds Creek) and 56 (Durfee Draw-Chevelon Canyon) have the highest proportion of potential for active crown fire (68 percent for both). If a wildfire were to burn within these watersheds, detrimental post wildfire effects would be expected.

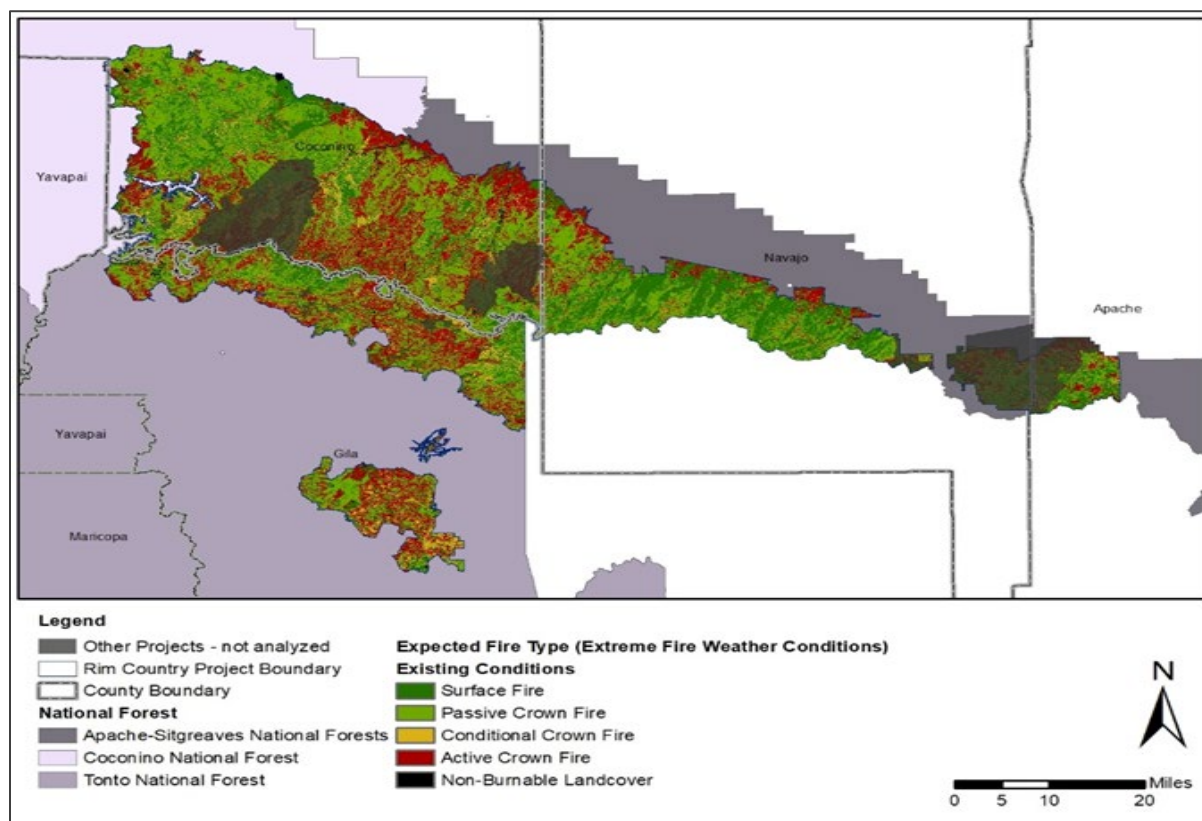


Figure 56. Expected fire type for existing conditions, under modeled weather conditions

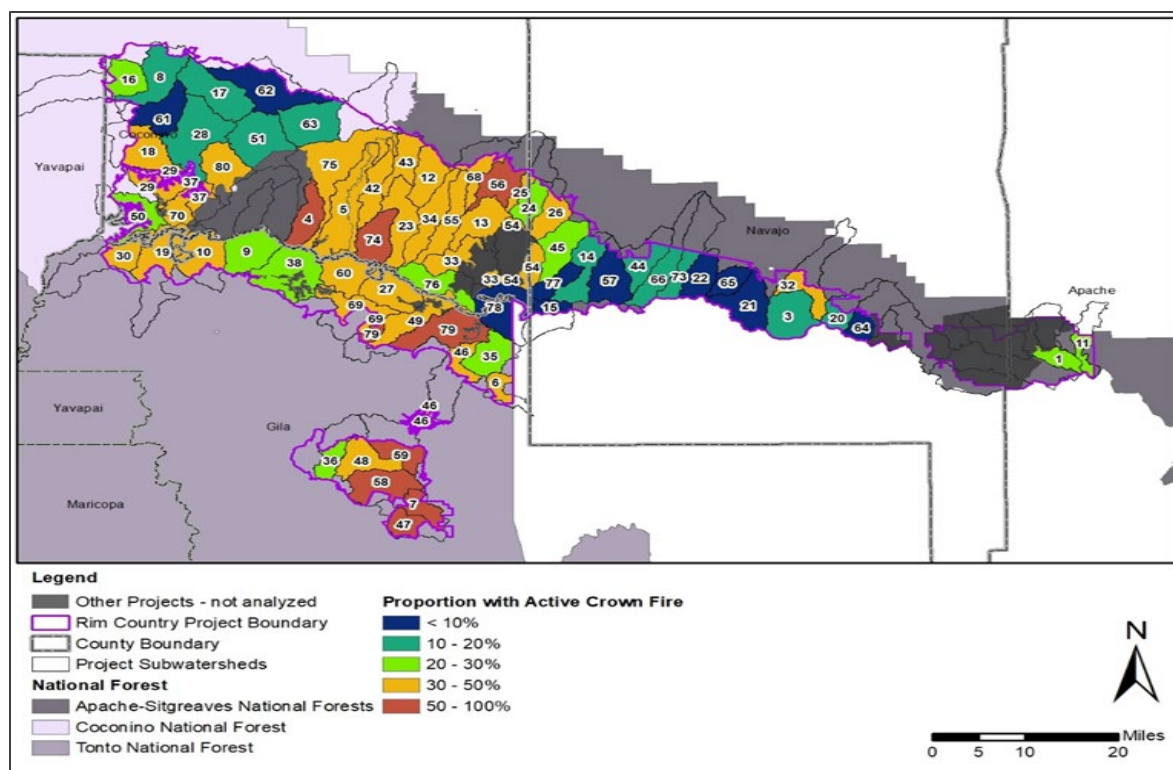


Figure 57. Existing conditions proportion of HUC6 watersheds with expected active crown fire, under modeled weather conditions

Fire Hazard Index

(Section added from DEIS fire ecology specialist report for consistency, highlight indicates new information)

Currently 36 percent of the Rim Country project area has a fire hazard index of moderate or higher (figure 58), which presents difficult and dangerous suppression conditions during a wildfire and potential for adverse post fire effects on soils and surface water quality. Four percent of the landscape is in the very high category.

There are 20 watersheds with over 50 percent⁶ of the watershed in the moderate to very-high fire hazard index categories (figure 59). Watershed 7 (Reynolds Creek, 76 percent) and 59 (Upper Spring Creek, 77 percent) have the highest proportion of fire hazard index in the moderate to very high class. Large wildfires in these watersheds have a high potential to be difficult and/or dangerous to suppress, and for adverse post fire effects.

⁶ Percentage values are based on National Forest System lands only within a given watershed.

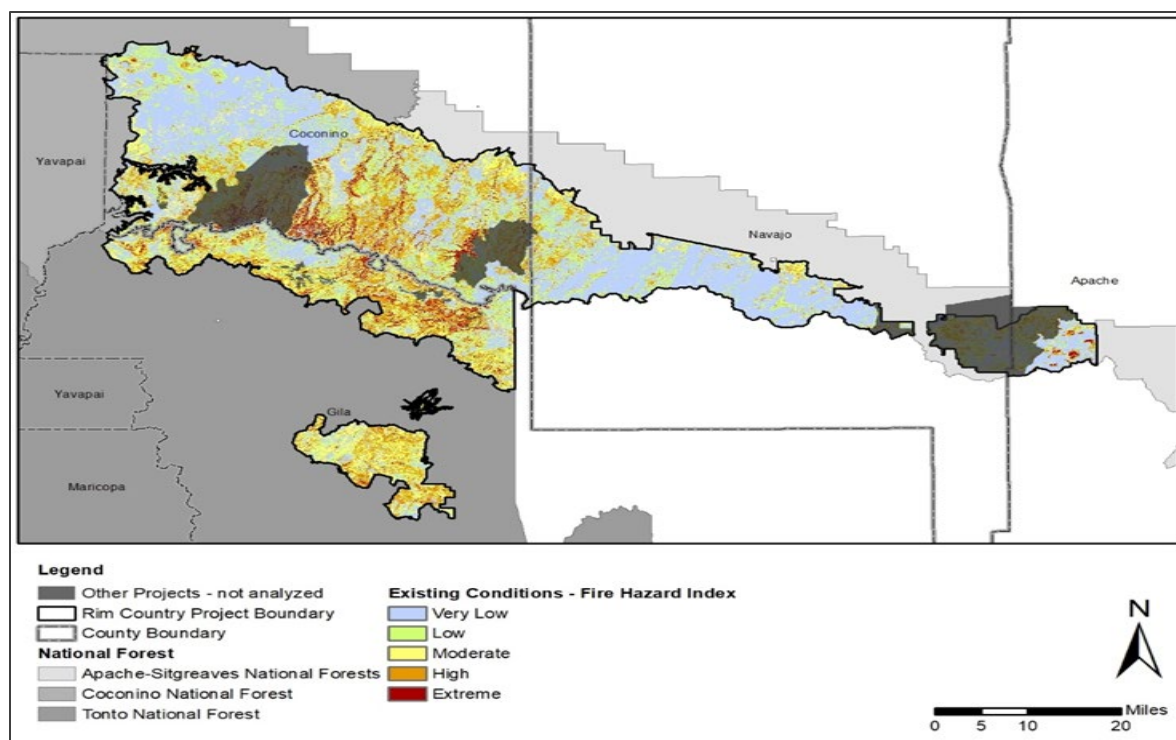


Figure 58. Fire hazard index for existing conditions, under modeled fire weather

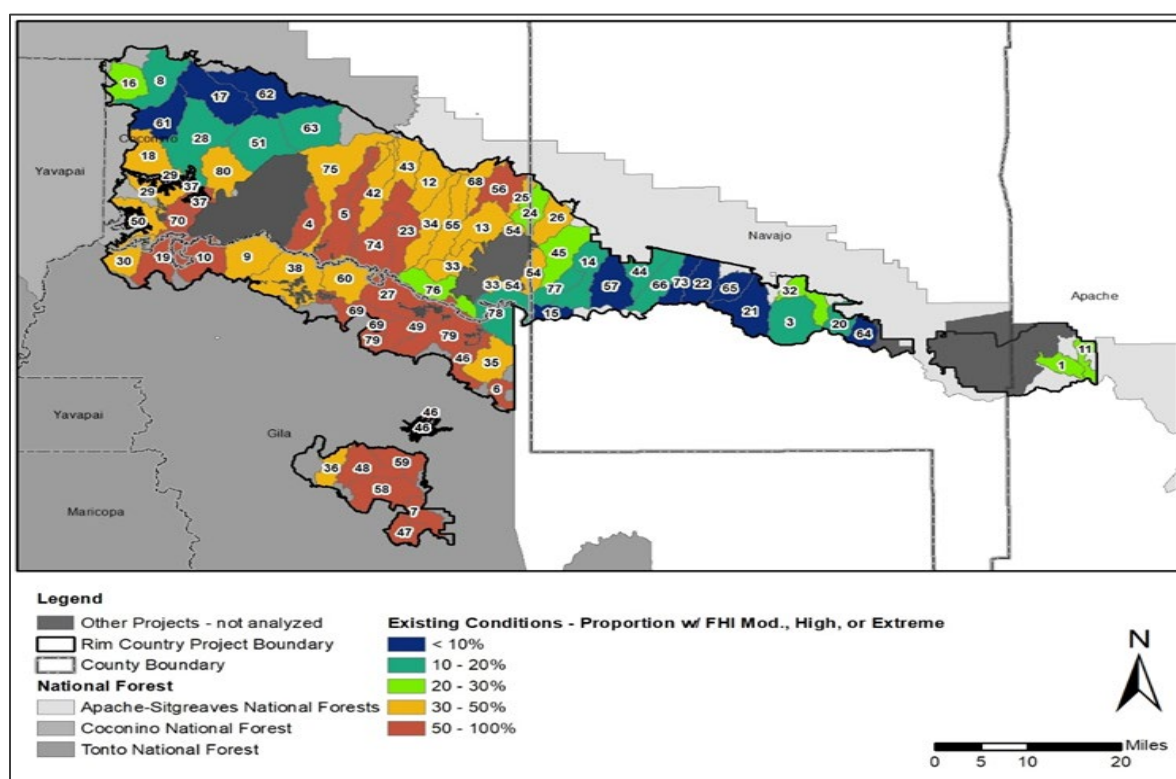


Figure 59. Proportion of each HUC6 watershed with fire hazard index in the moderate, high or very high category for existing conditions, under modeled fire weather

Burn Probability

Because of the varied geography, topography and fuels across the project area, not all portions of the landscape have the same likelihood of burning.

By modeling very large numbers of fires across the project area landscape under the full range of fire weather conditions typical throughout the full fire season, we can identify which portions of the landscape are most likely to burn. Utilizing the large fire simulator (FSIM) overall annual burn probability has been calculated for the Rim Country project area. As illustrated in figure 60, some portions of the project are inherently more likely to burn in a given fire year.

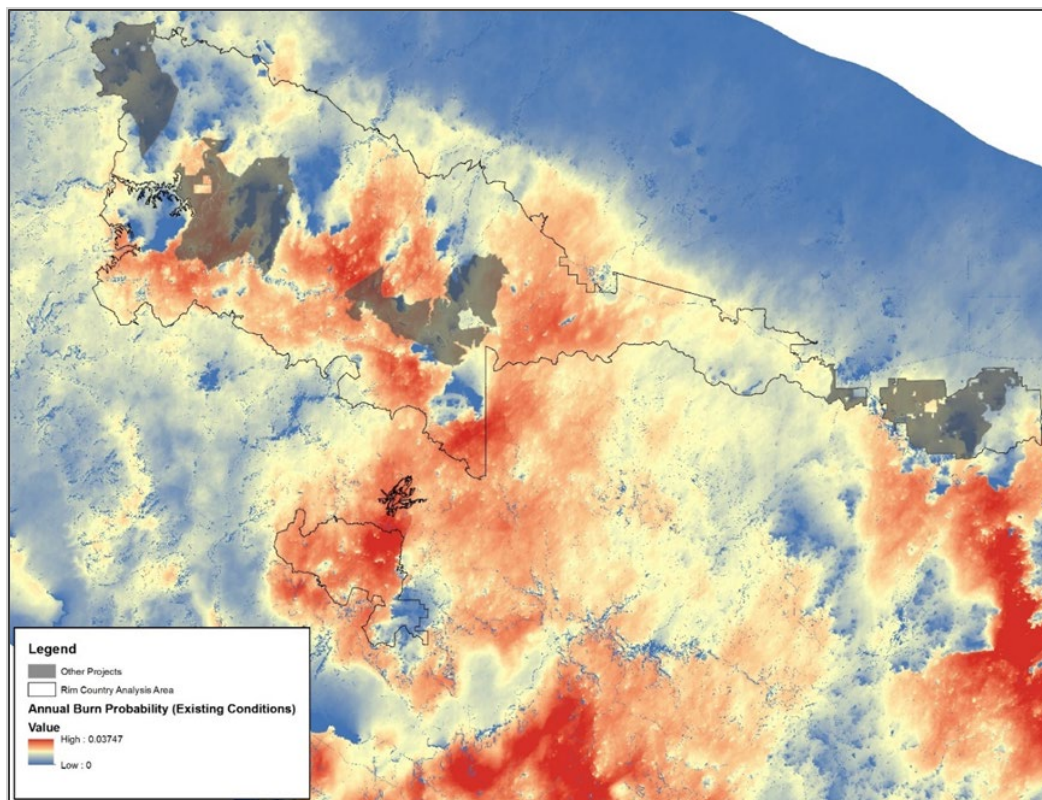


Figure 60. Annual landscape burn probability (existing conditions)

Assumptions and Methodology

In the analysis of this resource the following assumptions were made:

All mechanical treatments were modeled to have occurred in 2019, and all areas proposed for burning were modeled to have burned in 2024 and again in 2034. In reality, treatments would be spread out over several years. The specific timing of mechanical treatments would depend on the contract/contractor, road conditions, and numerous factors that are impossible to predict years in advance. Prescribed fire implementation depends on weather conditions, fuel conditions, other fires in the area, available resources, and multiple other variables that are impossible to predict weeks in advance. During the implementation period, untreated areas would be vulnerable to the effects as described in the Existing Condition and/or the alternative 1 (no action), depending on the applicable time period. Modeling results presented do not include partial treatment, such as would be the case partway through implementation. Details on the treatments modeled can be found in the Silvicultural Specialist report (USDA FS 2022).

The prioritization of treatment areas will be a part of the implementation of Rim Country, though broad recommended methodology is presented here. Results were analyzed to compare the effectiveness of each action alternative against the no-action alternative (alternative 1). Concepts that are necessary for a thorough understanding of this analysis are discussed when they are first presented. Additional information on modeling and concepts may be found in the fire ecology and air quality specialist reports, the silvicultural specialist report and the associated appendices.

The discussion of effects is based on guidance that all best management practices, design features, and mitigations are applied during implementation. Effects discussions are based on modeled fire behavior, modeled emissions, and proposed treatments for which the methods and assumptions are detailed in this section and in the Fire Ecology, Air Quality, and Silviculture Specialist reports (USDA FS 2022).

Scales of analysis

The alternatives in this analysis are evaluated at multiple scales to ensure the expected effects are being considered in the appropriate context.

In order of decreasing size, with the largest first:

- 1. Rim Country Project Area:** This includes the entire area analyzed for treatment, including comprehensive restoration, at 1,240,000 acres. It includes large areas on which the Rim Country analysis is not recommending treatments. (figure 2)
 - ♦ **Hydrologic Unit Code (HUC):** Proposed treatments will be analyzed and evaluated at the 6th level HUC. To be included, at least 30 percent of the watershed had to be within the Rim Country Project Area, resulting in 80 watersheds being analyzed. The watersheds range in size from 7,176 acres to 39,135 acres, with a mean size of 18,465 acres. (figure 61).

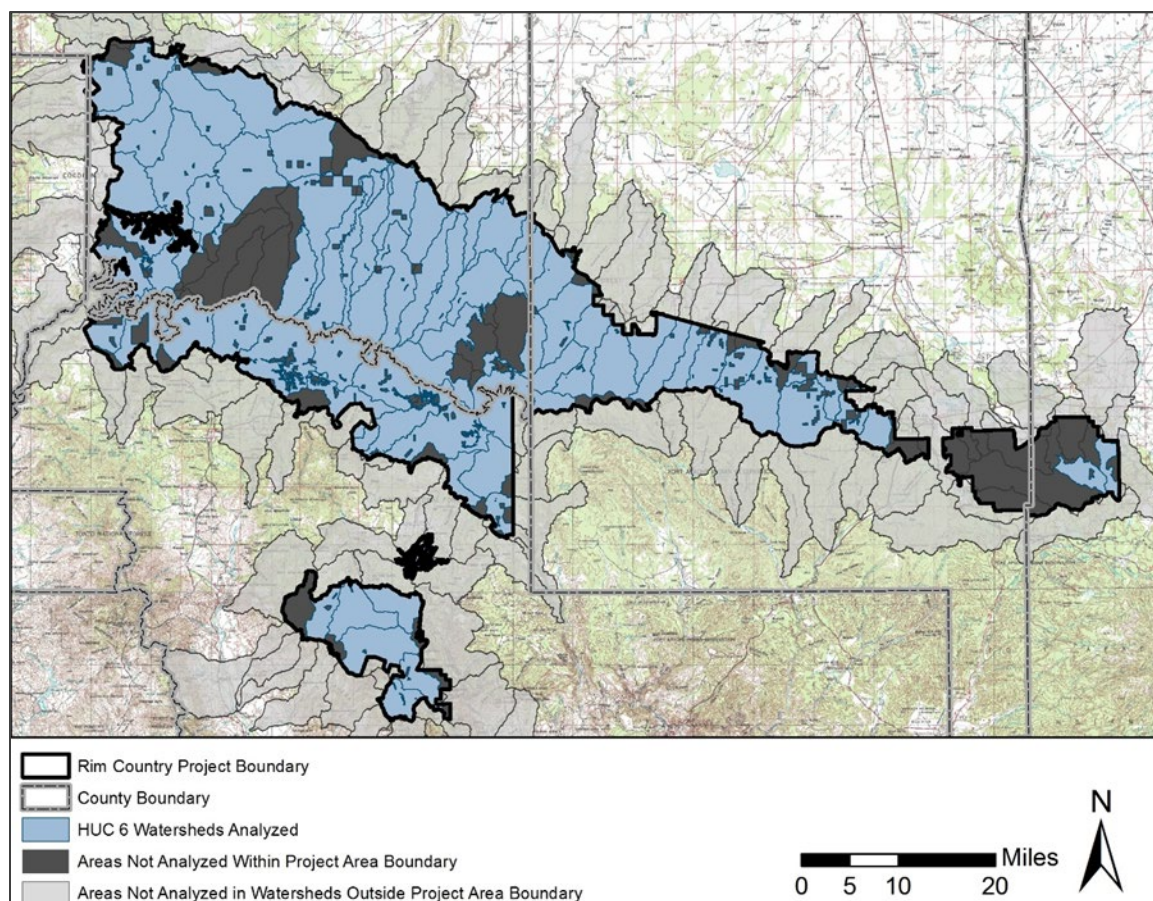


Figure 61. HUC 6 Boundaries - Dark gray areas are areas that are not being analyzed in this report, they represent other project areas, non-forest system lands, and portions of watersheds with less than 30 percent of their area within the project area. Light gray areas are HUC 6 boundaries that fall outside the project area and were not analyzed in this report.

Metrics & Measures

Throughout this analysis, there are references to ‘undesirable fire behavior and effects.’ Where it is legally and practically possible, ‘desirable’ fire behavior and effects align with reestablishing natural fire regimes, and that is the intent across the majority of the project area. Examples of where it is not possible to restore the natural fire regime include, but are not limited to, the following:

Example 1: Mexican spotted owl habitat: Where there are nest cores, in particular, there is a need, legally and biologically, to manage those areas for denser vegetation than may have existed there historically. That means that, in most cases, fire will need to be less frequent than it would have been historically, and there is a desire to prevent high-severity fire in those areas.

Example 2: Proximity to infrastructure for certain vegetation types. Some of the ponderosa pine/evergreen oak and adjacent Chaparral/Madrean cover types historically would have had components of high-severity fire as part of their natural fire regimes. Where these cover types occur on steep slopes above vulnerable assets, it may be necessary to manage these areas for lower severity fire.

The metrics used to evaluate the effectiveness of the alternatives in meeting the purpose and need of the project are described in detail below. A comparison of the outputs of these metrics between alternatives is displayed in table 38.

Table 38. Brief description of the metrics used in this analysis

Metric	Application	Issues Addressed	Assets and Resources Addressed
Fire Type	Indicates potential fire behavior at all scales analyzed. Crown fire is one an indicator of high-severity fire.	Landscape and habitat resilience to wildfires burning under extreme conditions, vulnerability of values	Fire Management, Wildland Urban Interface, Old Trees, Vegetation Cover Type, Watershed Response
Fire Hazard Index	See Assumptions and Methodology – Fire Hazard Index page 221 for details.	Landscape/habitat resilience to wildfires burning under extreme conditions, including both first and second order fire effects, and wildfire suppression difficulty.	Fire Management, Wildland Urban Interface, Vegetation Cover Type, Watershed Response
Total Surface fuel loading (Litter + Duff + Fine Woody Debris + Coarse Woody Debris)	Surface fuel loading is used to indicate potential for surface fire severity and intensity, particularly in areas where there may not be crown fire.	Potential for high burn severity and high-severity effects from both prescribed fire and wildfire from first and second order fire effects.	Old Trees, Vegetation Cover Type, Watershed Response,

The effects of wildfire as quantified by the metrics and measures have direct implications for a variety of highly valued resources and assets. The resources and assets analyzed in this analysis will include:

1. Fire management
2. Wildland urban interface
3. Old trees
4. Vegetation cover type

Fire Modeling

The intent of the fire modeling in this analysis is to identify the areas at greatest risk of undesirable fire behavior and first and second order fire effects, and what the expected effects would be for each of the alternatives. Additional details for fire modeling can be found in the Fire Ecologist Specialist report (USDA FS 2022). The primary fire modeling for this effort includes conditional fire effects. These outputs represent the likely results if the entire landscape burns under the specified fire weather inputs. Actual wildfires do not naturally burn this way, but rather burn with variance in burn conditions throughout individual burn periods and throughout the fire season. Nevertheless, conditional fire models can be helpful when evaluating relative “problem” areas on the broader landscape and help highlight overall changes in conditions between alternatives when subjected to extreme fire weather conditions have led to large problem fires in and adjacent to the project area.

One of the objectives of the Rim Country EIS is to reduce the likelihood of uncharacteristic wildfires, including large, high-severity fires. Modeling fire behavior using conditions under which an uncharacteristic fire is known to have occurred allows for increased accuracy of post-treatment modeling results (McHugh 2006). This analysis used the Rodeo/Chediski Fire, which was a large, complex fire that burned in 2002 on the Tonto and Apache-Sitgreaves National Forests, including about 100,000 acres within the Rim Country project area.

Data for modeling fire behavior is based on a landscape spatial information with describes the fuel and topographic characteristics of an area, at a 30 square meter (0.22 acre) resolution. The landscape file was created using a combination of Landfire 2014 data (LF1.4.0), Lidar data, Forest Service stand data (USDA FS 2022) and satellite imagery (NAIP, USFS Resource Photography). Existing condition fuel models were assigned based on a combination of Landfire Existing Vegetation Type (EVT), canopy cover,

canopy height and past disturbance. The predominant Landfire EVT was modified to match the FSVeg stand vegetation cover type, while non-burnable surfaces and riparian corridors were left unmodified regardless of stand vegetation cover type. Lidar data was used to create canopy cover and canopy height rasters. Mapped disturbances including mechanical treatments, prescribed fire and wildfire from 2008 to 2017 were used to further modify fuel model assignments.

Fire behavior for alternative future conditions used outputs from the Forest Vegetation Simulator Fire and Fuels Extension (Dixon 2003; Rebain 2016) to adjust data for modeling the effects of actions, or no actions, proposed in the alternatives. Post-treatment landscape files were modified from the existing conditions using the percent of change to canopy characteristics output from forest vegetation simulator-FFE. The resulting stand characteristics informed the assignment of post-treatment fuel models using the Landfire Total Fuel Change tool (LFTFC v0.160).

Fire Type

In ponderosa pine and most of its associated vegetative communities, the expected type of fire is a good indicator of the health and resilience of the ecosystem. Crown fire in ponderosa pine is lethal to the tree, therefore the amount and distribution of crown fire activity is an important indicator of the health of a frequent fire forest. Fire types include active crown fire, conditional crown fire, passive crown fire, and surface fire as described below.

Fire type was evaluated at the Rim Country project area level and at the 6th level hydrologic unit code (HUC) and in order to facilitate an analysis of specific fire effects in different areas. Watershed impacts from fire increase with the proportion of the watershed burned at high severity (Cannon 2010; Neary 2011). Therefore, fire type is considered at all scales in those areas proposed for thinning and/or prescribed fire.

Fire Hazard Index (FHI)

Five datasets were used to identify areas of high probability for severe fire effects, extreme behavior and a complex fire management environment. These datasets are crown fire potential, fireline intensity, heat per unit area, slope, and soils with high erosion potential.

The fire hazard index classified the landscape as shown in table 39. The fire hazard index was evaluated at the Rim Country project area level and at the 6th level hydrologic unit code (HUC) and to facilitate an analysis of specific fire effects in different areas. Resource impacts and fire management responses will change with the proportion of the watershed in high hazard classes. Therefore, fire hazard index is considered at all scales in those areas proposed for thinning and/or prescribed fire.

Table 39. Fire hazard index scores used to identify the need for treatment for resources, values and assets

Rating	Comments
1 – very low	Conditions are such that expected fire behavior will have minimal negative impacts to resources and suppression efforts, where needed, are expected to be very effective
2 – low	From a fire perspective, areas where crown fire is expected will not pose a threat to soil stability. Areas of high erosion potential are not expected to burn with active crown fires or high intensity conditions. Use of ground resources for suppression efforts becomes increasingly difficult.
3 – Moderate	Either extreme fire behavior resulting in difficult to control fires, or moderate soil severity. Presence of steep highly erodible soils may coincide with crown fire and higher intensity fires. Control of wildfire by suppression efforts will be difficult.
4 – High	These areas have the highest expected levels of all the fire behavior metrics. Control of wildfire by suppression efforts will be difficult and complex.
5 – Very High	These areas have the highest expected levels of all the fire behavior metrics, as well as steep slopes and highly erodible soils, making them prone to adverse second order effects such as debris flows. Control of wildfire by suppression efforts will be difficult and complex.

Surface Fuel Loading

In this analysis, total surface fuel loading includes fine dead woody debris less than or equal to 3 inches in diameter (fine dead woody debris), dead coarse woody debris greater than 3 inches in diameter, litter, and duff. Fine dead woody debris and litter contribute significantly to fire behavior as well as fire effects, while and course woody debris and duff are mostly of interest in regard to fire effects (both direct and indirect). All three land management plans provide specific direction on desired conditions for course woody debris, but are silent or do not quantify any other components of surface fuel loading. In this analysis, course woody debris, fine dead woody debris, litter, and duff were combined as “total surface fuel loading” in tons per acre, which is evaluated both qualitatively and quantitatively regarding potential fire effects. Recommended surface fuel loadings are estimates, based on the best available science and expert opinion (Ottmar 2015) on the interaction of surface fuel loading with fire behavior and fire effects

Fuel loadings were evaluated at the Rim Country project area level and the 6th level hydrologic unit code (HUC) and to facilitate an analysis of specific fire effects in different areas. Water, soil and wildlife impacts from wildfire are also related to surface fuel loadings.

There are no desired conditions for total surface fuel loading, but 20 tons per acre is a reasonable recommendation for average maximum surface fuel loading for the area of this analysis (see related discussion in the Fire Ecologist Specialist report, USDA FS 2022). Historic levels were estimated to be 5 to 20 tons per acre for course woody debris alone.

Environmental Consequences

Throughout this section, changes directly attributable to proposed actions, such as thinning or prescribed fire, are direct effects. These include changes to shading, canopy continuity, canopy base height, consumption of surface fuel, etc. Changes to the potential behavior and effects of future wildfires that result from the direct effects are considered indirect effects. Effects of proposed actions for stream restoration and roads are discussed separately from those of thinning and prescribed fire.

Alternative 1 – No Action

Direct and Indirect Effects

Under alternative 1, there would be no changes to current management. Alternative 1 would not meet the purpose and need of this project because most of the ecosystems and natural resources within the treatment area would continue to degrade. The treatment area would not move toward desired conditions. This alternative would not reduce the risk to human lives nor would it result in safe, cost-effective fire

management that would protect, maintain, and enhance National Forest System lands, adjacent lands, and lands protected by the Forest Service under cooperative agreements. As required by FSM 5100 (page 9).

The direct and indirect effects of alternative 1 relate to the effects of the continued degradation of surface and canopy fuel conditions, and the effects of the continued interruption of the natural fire regimes. These include the potential for the direct effects of large, high-severity wildfires occurring within the project area. The indirect effects of such burns could also compromise water resources due to post-fire flooding and debris flows. Indirect effects could also include impacts to air quality downwind and downslope of fires. The most likely impacts to air quality being locations northeast of the project area, and in low areas, such as the Verde Valley, Snowflake, and Show Low.

Fire Type

Fires that do occur in the project area would be wildfires; some of which could be beneficial, and some could be catastrophic or detrimental, depending on environmental conditions at the time of the fire, and the condition of the forests at the time they burn. If historic patterns of burn severity were to continue, approximately 73 percent of the area burned in wildfires larger than 1,000 acres would burn with low severity effects that could be beneficial. However, given extreme weather conditions, there would be an increased potential for crown fire compared to the existing conditions. All crown fire types (both active and passive) can be expected across approximately 79 percent of the project area under extreme weather conditions (figure 62) up from 73 percent in the existing conditions. Approximately 32 percent of the projected area has the potential to burn with active crown fire, up from 30 percent in the existing conditions.

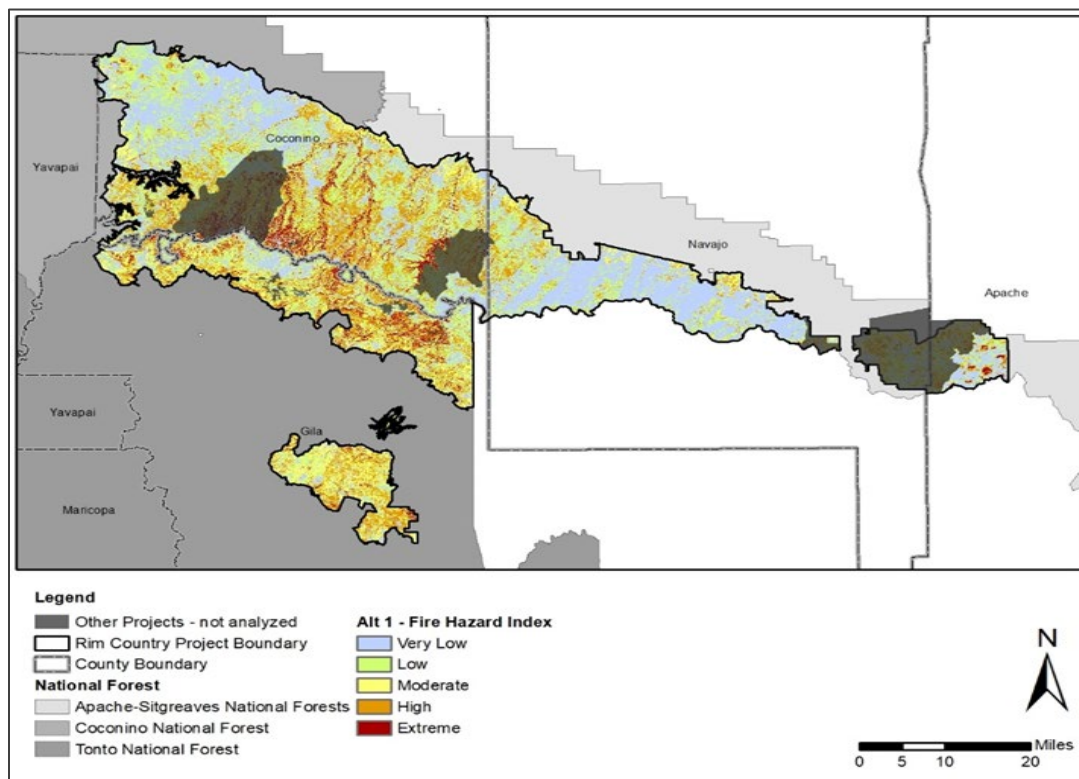


Figure 64. Fire hazard index for alternative 1, under modeled fire weather

Post wildfire watershed effects increase with the percentage of the watershed that burns at moderate to high severity (Cannon, 2010; Neary 2011). Under alternative 1, 47 watersheds are expected to burn with active crown fire under extreme weather conditions for over 30 percent of the watershed, resulting in high-severity effects (figure 63). Eleven watersheds have over 50 percent of the watershed expected to burn with active crown fire. Watersheds 56 (Durfee Draw-Chevelon Canyon) and 7 (Reynolds Creek) have the highest proportion of potential for active crown fire (68 percent for both). If a wildfire were to burn within these watersheds under extreme fire weather conditions, detrimental post wildfire effects would be expected.

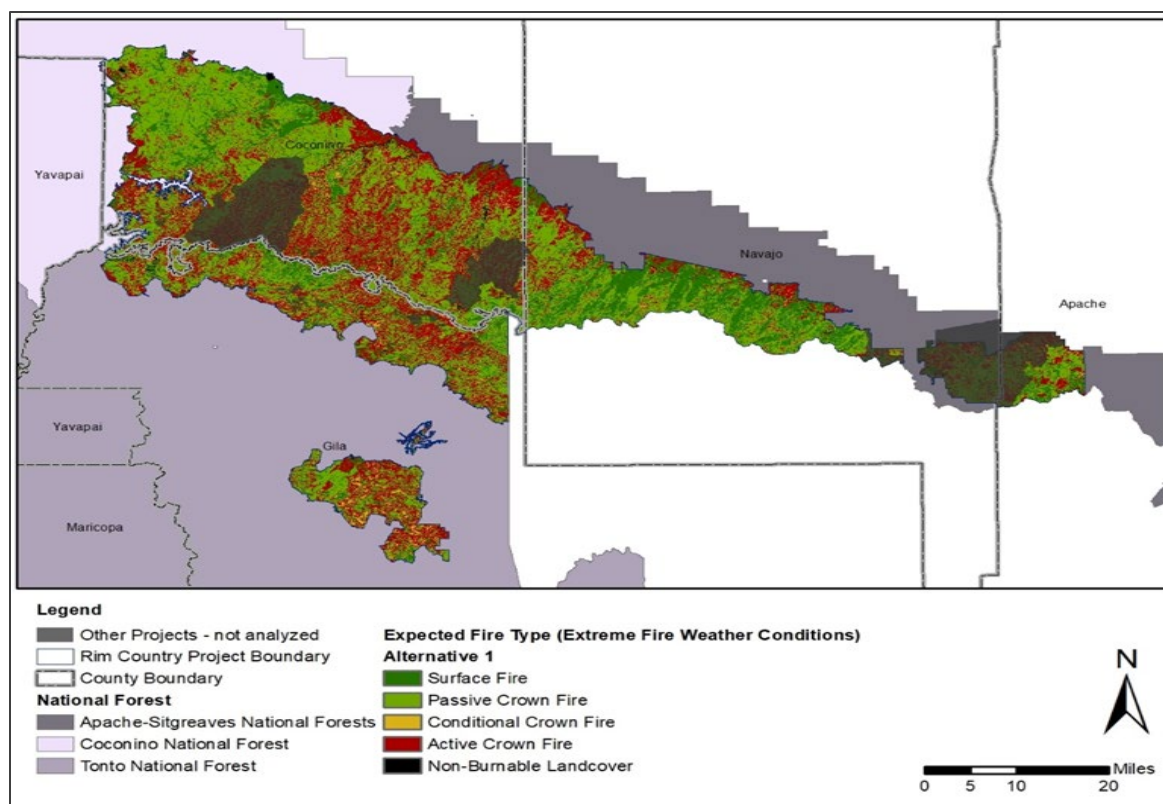


Figure 62. Expected fire type for alternative 1, under modeled weather conditions

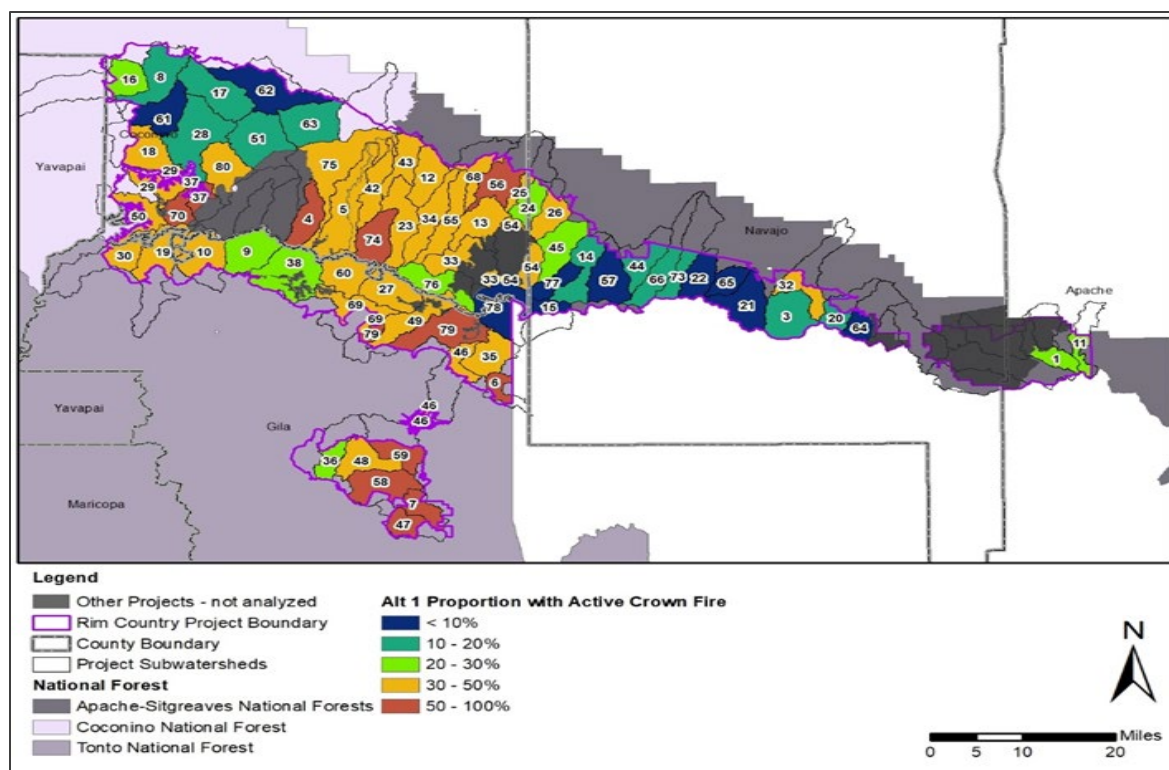


Figure 63. Alternative 1 proportion of HUC6 watersheds with expected active crown fire, under modeled weather conditions

Fire Hazard Index

The expected short-term (less than 20 years) effects of alternative 1 would include an increased risk of undesirable wildfire behavior and effects. Wildfire behavior and effects could threaten lives, resources, and infrastructure. Thirty-nine percent of the project area is within the moderate to extreme fire hazard index, which presents difficult and dangerous suppression conditions during a wildfire and potential for adverse post fire effects on soils and surface water quality, up from 36 percent in the existing conditions (figure 64).

There are 24 watersheds with over 50 percent of the watershed in the moderate to very high fire hazard index categories (figure 65). Watershed 7 (Reynolds Creek, 80 percent) and 107 (Upper Spring Creek, 77 percent) have the highest proportion of fire hazard index in the moderate to very high class. Large wildfires in these watersheds have a high potential to be difficult and dangerous to suppress and have a high potential for adverse post fire effects.

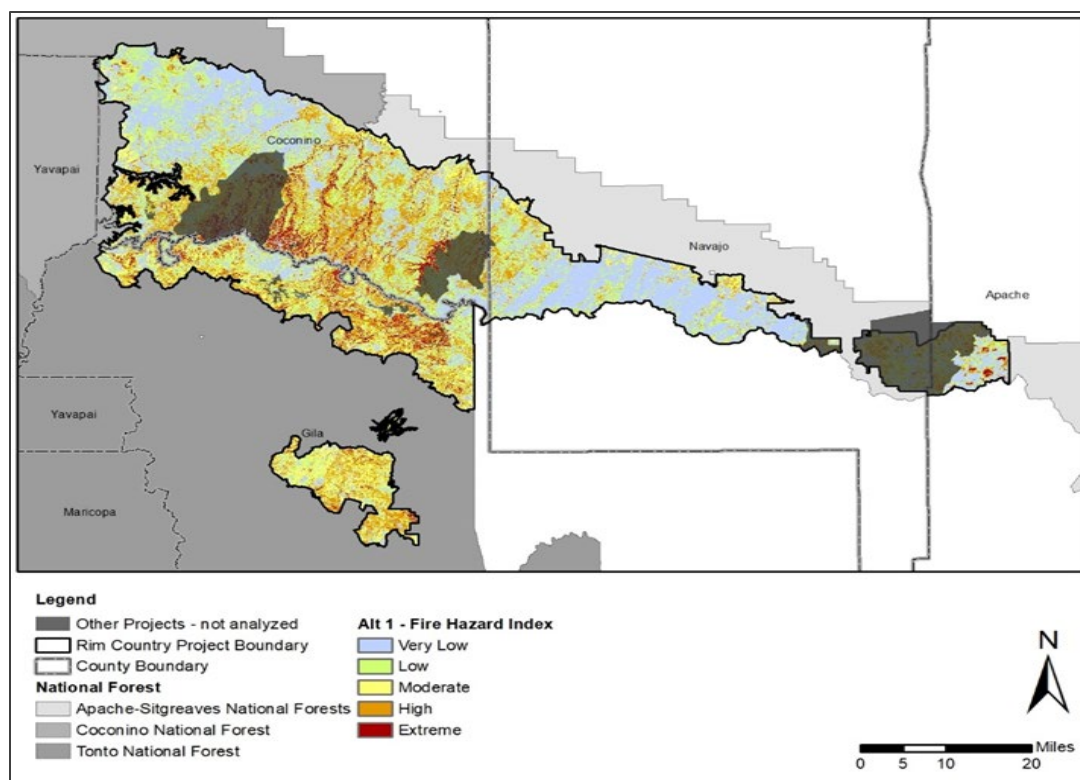


Figure 64. Fire hazard index for alternative 1, under modeled fire weather

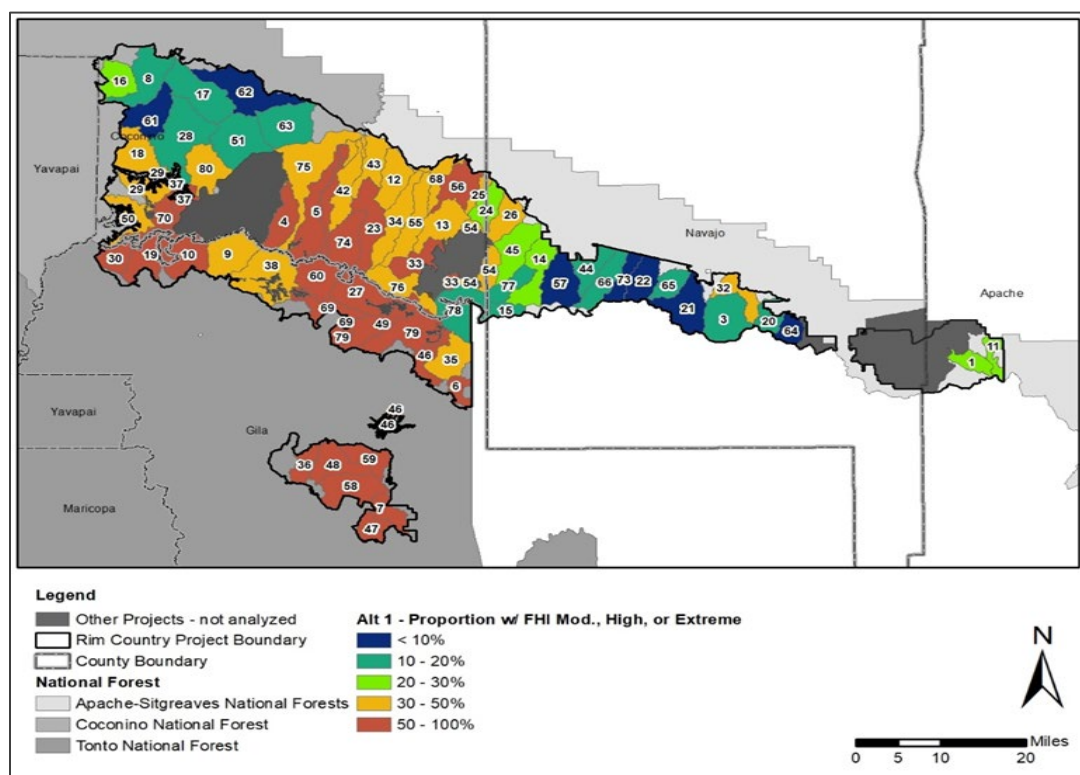


Figure 65. Proportion of each HUC6 watershed with fire hazard index in the moderate, high or very high category for alternative 1, under modeled fire weather

Wildfire Management

(Paragraph added from fire ecology specialist report for consistency) Wildfire management environment would become increasingly complex as both CFA and fire hazard index increase. Under extreme fire weather, suppression tactics would continue to be non-effected and dangerous.

Wildland Urban Interface

Under the no action alternative, wildland urban interface areas across the treatment area would be threatened by the increasing extent of high severity of wildfires (table 40). Active crown fire (CFA) and fire hazard index (FHI) are both expected to increase. The potential for home and asset loss from crown fires, high intensity surface fires and ember lofting would continue to increase.

Table 40. Wildland urban interface (WUI) measures and metrics for alternative 1

Alternative 1		Fire Hazard Index				Fire Type	
WUI Class	Total Acres	Very Low - Low	Moderate	High	Very High	Passive & Active Crown Fire	Active Crown Fire
Communication Sites	13,333	64%	14%	19%	3%	81%	28%
FS Buildings & Rec Residences	10,548	60%	11%	23%	6%	83%	33%
High Value Rec Sites	5,581	61%	9%	22%	8%	85%	33%
Non FS Land with Structures	144,691	63%	16%	18%	3%	75%	29%
Transmission Lines	28,885	63%	15%	17%	4%	74%	32%

FS – Forest Service

Vegetation Cover Types

In the long term (greater than 20 years), tens of thousands of acres (the actual amount would be a subset of the 334,800 acres in the treatment area that would likely burn with high-severity effects) would potentially be converted to non-forested systems as a result of high-severity fire. Aspen stands would continue to decline, and some stands would be likely to disappear. Woody species continue to encroach into grasslands and shrublands and sprouting shrubby species would increasingly occupy understories in Ponderosa Pine Evergreen Oak. Table 41 shows the metrics for each vegetation cover type.

Table 41. Vegetation cover type measures and metrics for alternative 1

Vegetation Cover type	Total Acres	Very Low - Low FHI	Moderate FHI	High FHI	Very high FHI	Fire type: Passive & Active Crown Fire	Fire type: Active Crown Fire
Ponderosa Pine	642,198	75%	7%	16%	2%	82%	22%
PIPO Evergreen Oak	147,989	36%	33%	26%	5%	85%	30%
Mixed Conifer - Frequent Fire	49,281	26%	18%	29%	27%	77%	54%
Wet Mixed Conifer	3,130	24%	7%	32%	37%	77%	74%
Aspen	1,438	91%	1%	5%	3%	6%	5%
Pinyon Juniper	135,085	37%	32%	28%	3%	71%	67%
Madrean Pinyon Oak	23,318	19%	33%	41%	7%	86%	80%
Grasslands	18,851	98%	1%	0%	0%	16%	2%
Riparian Areas	14,567	71%	11%	13%	5%	49%	19%

Large and old trees

Under the no action alternative, large and old trees across the treatment area would be threatened by the increasing extent of high severity of wildfires (Swetnam 1990a; Covington and Moore 1994; Swetnam and Betancourt 1998; Westerling et al. 2006). In areas where a wildfire would be a first entry burn and there had been no prescribed fire or thinning, there would be a much greater potential for mortality than in previously treated areas. In this alternative, many old trees would be killed or damaged by wildfire, as well as those trees that die or decline slowly from the cumulative effects of fire and other stressors (Minard 2002).

Surface Fuel Loadings

Under the no action alternative, surface fuel loading would continue to accumulate. This would lead to high burn severity (fire effects to soil) as residence time increases with increasing surface fuel loading. coarse woody debris (dead/down woody fuels greater than 3" in diameter) could be expected to switch from predominantly sound to predominantly rotten debris after about 15 years with no fire, with the highest coarse woody debris loading expected from 6 – 12 years after the last fire (Roccaforte et al. 2012). Desired conditions for total surface fuel loadings are less than 27 tons per acre in Ponderosa Pine vegetation types and less than 30 tons per acre in dry mixed conifer. Under Alternative 1, 121,021 acres exceed recommended levels, up from 72,285 acres in existing conditions. 101,594 acres of Ponderosa Pine and 19,427 acres of dry mixed conifer vegetation types exceed recommended fuel loadings (figure 66).

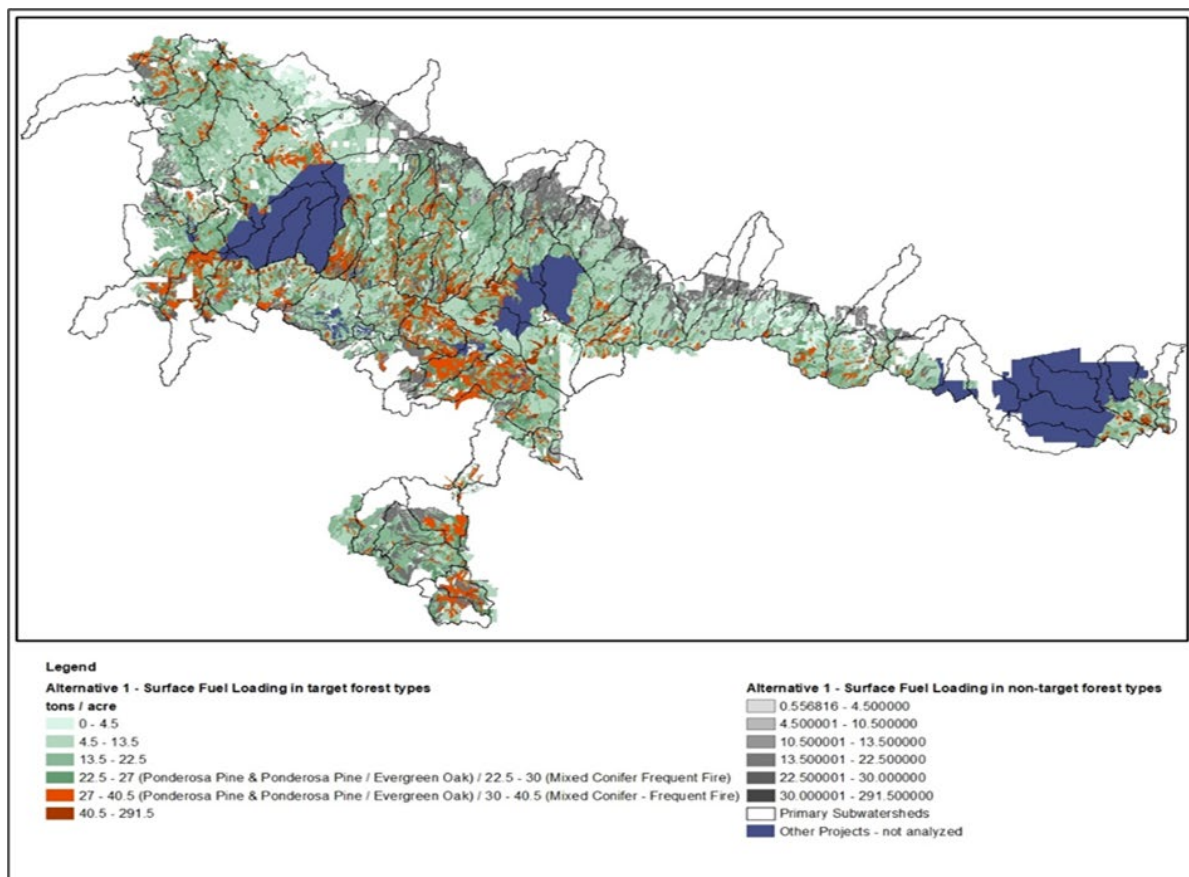


Figure 66. Surface fuel loads for alternative 1, under modeled fire weather

Unavoidable Adverse Effects, Irreversible and Irretrievable Commitment of Resources

As described above, with no treatment, high-severity fire effects would become more widespread, and extreme fire behavior would become more common. In recent years, fires in the area have taken human lives, destroyed homes/property/infrastructure, and produced high-severity effects across large areas not adapted to high-severity fire including 2002 Rodeo/Chediski Fire (469,000 acres), 2011 Wallow Fire (538,000 acres), and 2012 Whitewater Fire (approximately 297,000 acres). There is broad consensus that such fires will continue to burn in this area if no action taken, though the specific extent and location of the negative effects could not be known until an incident occurs. First order effects would include (but are not limited to): chemical and physical changes to soil, high levels of mortality across approximately 27 percent or more of the burned area (assuming approximately 27 percent high severity), consumption and/or killing of the seed bank, consumption of organic material in soil, including flora and fauna, conversion of forested habitat to non-forested habitat. Second order fire effects would include (but are not limited to) erosion, flooding, debris flows, destroyed infrastructure, changes in visitation to the forest and the economies of local businesses that depend on visitors and natural resources, and degradation of water resources for wildlife, livestock, and humans. Some of these effects would last just a few days or weeks, some would take much longer. For example, topsoil is critical to healthy surface vegetation and would take centuries to recover though, with climate change, it is unknown exactly what the ecological trajectory would be. The loss of old growth and old trees would require decades to centuries to recover.

Effects Common to Both Action Alternatives

Activities that would affect fire and fuels include mechanical treatments and/or prescribed fire. While the number of acres of prescribed fire and mechanical treatments varies by alternative, their effects, where implemented, would be the same.

Mechanical treatment alone has the potential to alter fire behavior primarily through a reduction of CBD, but it can also increase surface fuel loadings through the placement of slash on the ground (Carey and Schuman, 2003). Carey and Schumann (2003) further note that the use of mechanical thinning alone has a varied effect on modifying fire behavior, primarily because of the created slash. All of the thinning treatments proposed within this analysis are paired with prescribed burning, therefore, the effects will be a combination of thinning and burning. Various researchers have concluded that the combination of thinning and burning as the most effective way to alter fire behavior (Strom 2005; Graham et al. 2004; Peterson et al. 2005; Cram et al. 2006).

The effectiveness of using prescribed fire as a tool, alone or combined with mechanical treatment, to restore ponderosa pine to a healthier, more sustainable and resilient condition is well documented (Fulé et al. 2001b, Roccaforte et al. 2008, Strom and Fulé 2007, Fulé et al. 2012). Prescribed fire is used as a proxy for wildfires which allows for more control over where and when fire burns and often leads to lower overall severity and emissions.

Most of the effects of the natural role of fire could not be effectively replicated by means other than fire. These effects include nutrient recycling; seed scarification (by both heat and smoke); promotion of a mosaic of seedlings, shrubs, forbs, and grasses; regulating surface fuel loads, changes in soil moisture, changes to albedo, etc. (Laughlin et al. 2008; Pyke et al. 2010; Laughlin et al. 2011). Over time, prudent use of prescribed burning, particularly when combined with mechanical thinning, would reduce the potential for damage from wildfires, as well as the costs associated with fire suppression (Jaworski 2014). Fire increases structural heterogeneity and diversity and promotes natural regeneration of ponderosa pine, providing favorable seedbeds and enhancing the growing environment for survival (Harrington and Sackett 1992).

The proposed treatments would create a mosaic of interspaces and groups (of ponderosa pine) of various sizes that would be maintained with fire. This mosaic is also a mosaic of crown fire potential, with some groups having potential for crown fire under some circumstances, with the surrounding interspaces causing crown fire to transition back to surface fire.

Post-treatment conditions for the action alternatives would include openings that would be managed to promote regeneration. Prescribed fire would be an important tool for creating receptive seedbeds for successful regeneration by consuming surface fuels, creating bare, mineral soil, allowing seeds better contact with soil. As seedlings and small saplings mature, fire and competition would thin trees, maintaining the desired trajectory for a fire-dependent landscape, so that an appropriate number of seedlings survive to maintain healthy forest conditions.

The longevity of the effects of a prescribed fire depends on the specific effect being evaluated; the condition of the burned area before a burn; the conditions under which it burned, and post-treatment conditions (such as precipitation). For example, a denser forest will accumulate litter faster than a more open forest; soil conditions and moisture affect the rate of decay; the germination and survival of seedlings depends on cone production and environmental conditions for the first 2 to 3 years.

In the long term, fire would help maintain a shifting, sustainable, resilient mosaic of groups, interspaces, and openings. Without regeneration openings, even with fire, the space occupied by incoming regeneration would begin to fill in the interspaces and, in the long run, as the seedlings mature, it would increase horizontal and vertical canopy continuity so that, if crown fire did initiate, there would be potential for larger areas of high-severity effects.

Prescribed fires would be implemented, on all acres proposed for burning year which may include pile burning months in advance of broadcast burns. Ideally, prescribed fires would occur on an average of every 10 years, depending on yearly fluctuations in climate/weather at different locations within the treatment area. Some areas will have had prescribed fire or wildfire within the last 10 to 15 years, so prescribed fires that are implemented would be maintenance burns (see below). Limitations (wildlife concerns, smoke, funding, resource availability, etc.) may make it difficult to attain an average of a 10-year fire return interval across the proposed treatment area. Burning some areas on a slightly longer return interval may be warranted to reduce smoke in sensitive receptors as mitigation for prescribed fires.

Direct and Indirect Effects

In the short term (less than 20 years), where treatments are implemented, the potential for undesirable fire behavior and effects would be reduced by breaking up the vertical and horizontal continuity of canopy fuels, decreasing excessive surface fuel loads of litter and duff (direct effects). It would be expected that the growth of light, flashy fuels would be stimulated by post-treatment conditions (second order effects). Wildfire behavior would benefit the ecosystems in which it burned, and would not threaten lives, resources, or infrastructure, except where they are adjacent to, or near areas (such as Mexican spotted owl habitat or Wet Mixed Conifer) that were not treated as intensively as the rest of the treatment area at this time. Air quality impacts (indirect effects) could increase some as prescribed fires are implemented. During the implementation period, portions of the landscape will remain at risk for undesirable fire effects and unmanaged wildfire will likely contribute to these outcomes.

In the long term (greater than 20 years), potential for undesirable fire behavior, as assessed by changes to surface and canopy fuels, would remain lower than existing condition for about 37 percent of the Rim Country area proposed for treatment. Potential for undesirable fire effects, as assessed by changes to canopy and surface fuels, would remain lower than existing condition for about 31 percent of the

ponderosa pine in the treatment area. Improvements achieved through treatments will eventually dissipate without repeated and recurring fire (including both managed and unmanaged ignitions). Fire serves as a critical ecological driver in this landscape and unless maintenance burning continues in perpetuity, fire deficit will contribute to long term ecological instability. Impacts to air quality as a result of fire-related pollutants emitted as a result of prescribed fire could decrease some as the majority of the treatment area would be in maintenance burn mode, producing fewer emissions per acre. However, since there would be more acres burned, the number of days of air quality impacts could increase.

Thinning, whether or not slash was removed from the site, would give managers more control of the amount and timing of emissions. As thinning and first-entry burns are completed, burn windows would expand for larger areas so more burning could occur when ventilation was good. Fewer and healthier trees, as a result of thinning and would be more fire resistant, and understory and surface vegetation would become established. With lower surface fuel loading, and canopy fuels dependent on fire, burn windows would be broader than for initial entry burns. Decision space for managing unplanned ignitions would expand as Rim Country (and other projects) are implemented.

Fire Type

Decreasing the horizontal and vertical continuity of canopy fuels is a direct effect of the proposed treatments that would allow sunlight to reach the surface, increasing surface temperatures, and decreasing dead fuel moisture content at the surface. This, combined with increased surface winds with fewer trees blocking the wind, could increase surface fire intensity, flame length, and rate of spread even if surface fuels were the same before and after thinning (Omi and Martinson 2004, Scott 2003). Therefore, canopy fuel treatments reduce the potential for crown fire (indirect effect) at the expense of slightly increased surface fire behavior (fireline intensity, flame length, and rate of spread). However, critical levels of fire behavior (limits of manual or mechanical control) are less likely to be reached in stands treated to withstand crown fires, as all crown fires are uncontrollable. Although surface intensity may be increased after treatment, a fire that remains on the surface beneath a timber stand is generally more controllable (Scott 2003). After the first prescribed fire, surface fuels would be lower so, even with the changes described above, the potential fire behavior and effects would be improved following the treatments under alternatives 2 and 3.

Fire Hazard Index

Some components of the fire hazard index are fixed and not susceptible to changes due to proposed treatments. These components include slope and soil erodibility. While these components are necessary for determining potential fire behavior and/or post fire effects, treatments will not result in changes to these components. The rest of the components, which relate more directly to fire behavior, will be influenced by proposed treatments in ways consistent with those discussed above in the Fire Type section and below in the Surface Fuels section. Maximum reductions in fire hazard index will be achieved following the second re-entry prescribed fire. Following this, fire hazard index may begin to increase unless continued maintenance burning occurs in perpetuity.

Surface Fuels

Mechanical thinning alone can contribute significantly to decreasing the potential for crown fire by breaking up vertical and horizontal canopy fuel continuity, but does little, in the long run, to decrease surface fuel loading. Initial thinning impacts may include temporary fire ‘breaks’ where there are skid trails, or other surface disturbances, but surface fuels that are not removed from the treatment area remain a potential source of heat and smoke emissions. Effects may be spottier but, where fuels have been pushed into piles or furrows (intentionally or otherwise), they may smolder for days or weeks.

Litter, Duff, and woody fuels (course woody debris) greater than 3” diameter contribute more than other fuels to emissions. Mechanical thinning alone can contribute significantly to decreasing the potential for crown fire by breaking up vertical and horizontal canopy fuel continuity, but does not decrease surface fuel loading (Fulé et al. 2012). Initial thinning impacts may include temporary fire ‘breaks’ where there are skid trails, or other surface disturbance, but surface fuels are generally not removed from the treatment area, and remain a potential source of heat and emissions. Surface effects may be spottier following thinning because residual fuels often include jackpots or small piles. Where fuels have been pushed into piles or furrows, by design or happenstance, they may smolder for a long time.

A direct effect of prescribed fires would be the consumption of some course woody debris. Prescribed burning would produce new accumulations of course woody debris although an indirect effect of the burning would be the course woody debris it may be of a different stage of decay that does not fill the same ecological niche. Surface fuel loading can be managed with fire and felling techniques to increase or decrease woody debris in different size classes. A direct effect of alternatives 2 and 3 could be that some areas would be deficit in course woody debris for a few years following treatment but, given the trend shown, it would only be a few years before it met desired conditions again and, with maintenance burning, it should be possible to maintain desired levels.

Course woody debris could be expected to switch from predominantly sound to predominantly rotten debris after about 15 years with no fire, with the highest course woody debris loading expected from 6 – 12 years after the last fire (Roccaforte *et al.* 2012).

Large/old Trees

Ponderosa pine (*Pinus ponderosa* Dougl. ex P. & C. Laws) stands with late-seral features are found infrequently, owing to past management activities throughout western North America. Thus, management objectives often focus on maintaining existing late-seral stands. Observations over a 65-year period of stands with no past history of harvest showed substantial ingrowth in the smaller diameter classes and elevated rates of mortality among the largest mature trees in the stand. Adjacent stands, with combinations of thinning and prescribed fire, had far fewer high-risk mature trees and generally lower rates of mortality after treatment. Forecasts using individual-tree diameter growth and mortality models suggest that observed mortality in these stands with remaining old trees and a dense understory will continue in the absence of any treatment.

Where site specific mitigation is needed to limit damage or mortality to large or old trees, it is best accomplished by reducing accumulations of fuels within the dripline and in the immediate vicinity of the trees. These fuels may include litter, duff, accumulations of woody fuels, ladder fuels, or any fuel that could produce sufficient heat to lethally damage a tree, whether by high or low intensity fire. This can be accomplished manually, mechanically, or through fire treatments. Potential measures include implementing prescription parameters, ignition techniques, raking, wetting, leaf blowing, thinning, or otherwise mitigating fire impacts to the degree necessary to meet burn objectives.

Throughout the life of this project, it is likely that some large and/or old trees would be damaged or killed by prescribed fire. It would not be possible to mitigate every large and/or old tree over 40,000 to 60,000 acres of prescribed fire units each year. Data collected from restoration treatments in the White Mountains indicates that mortality of pre-settlement trees increased with thin/burn, or burn only treatments over controls, although those that survived grew significantly faster than those in untreated stands. Managers will have to consider tradeoffs between treatment options, and the increasing likelihood of the trees burning in wildfires under conditions that would be more extreme than conditions under which a prescribed fire would be conducted.

Mechanical treatments and prescribed fire would be implemented to help sustain large/old trees across the landscape, and make them more resistant and resilient to natural disturbances such as fire. Throughout the life of this project, it is likely that some large and/or old trees may be damaged or killed by prescribed fire, by direct and/or indirect effects, despite mitigation measures. However, under both alternatives thinning and prescribed fire would decrease potential fire effects in the vicinity of most old and/or large trees, decreasing the likelihood of lethal damage in the event of a wildfire.

Mitigation measures are unpredictable, and site specific (Kolb et al. 2007, Hood 2007), and some can have negative effects of their own. Raking, for example, can remove fine, live roots in the surface organic layers, which may compound the effects of additional shallow roots being damaged by fire, though it is unlikely to actually kill the tree (Progar *et al.* 2017). Low intensity fire that causes little crown scorch can stimulate resin production in old trees that may attract bark beetles, increasing tree mortality. Mitigation measures implemented a year or more before a burn, such as thinning or raking, may improve the health of the tree, improving its response to fire.

Effects Unique to Each Alternative

Alternative 2 – Modified Proposed Action

Alternative 2 proposes to conduct about 991,060 acres of mechanical and prescribed fire treatments which includes 117,640 acres of prescribed fire only treatments over about 20 years or until objectives are met. On average, 87,342 acres of vegetation would be mechanically treated annually. On average, 99,106 acres of prescribed fire would be implemented annually across the Forests (within the treatment area).

When analyzed at the scale of the treatment area, alternative 2 would meet the purpose and need by moving the project area toward the desired condition of having potential for less than 10 percent active crown fire under extreme weather conditions, lessening post fire detrimental effects and creating a safer and more effective firefighting environment.

This alternative would meet direction in the Forest Service Manual 5100 (page 9) which includes direction on Forest Service use of prescribed fire to meet land and resource management goals and objectives. Objectives of fire management on lands managed by the Forest Service include:

Forest Service fire management activities shall always put human life as the single, overriding priority. The proposed actions of the Rim Country fully support incorporation of the highest standards for firefighter and public safety and are expected to improve and enhance the safety of the public as it relates to wildland fire.

Forest Service fire management activities should result in safe, cost-effective fire management programs that protect, maintain, and enhance National Forest System lands, adjacent lands, and lands protected by the Forest Service under cooperative agreement. Rim Country proposes to achieve restoration by restoring ecosystems within the treated area to a condition so that fire, when it occurs, would be beneficial to the ecosystems in which it burns without threatening lives, property, or resources. This would be achieved by fully integrating local industry, mechanical and fire prescriptive treatments, and providing for sustainable supplies of goods, services, and social values through implementation of appropriate fire management activities.

Direct and Indirect Effects

From a fire ecology perspective, direct and indirect effects of alternative 2 relate primarily to treatments that include mechanical thinning, prescribed fire, or both to meet the purpose and need of the project.

Changes to potential fire behavior are the indirect effects of changes to fuel loading and structure. A direct effect of implementing alternative 2, would be changes to the horizontal and vertical continuity of canopy fuels. As that continuity is broken up, an indirect effect would be decreased potential for crown fire.

Thinning, whether or not slash was removed from the site, would give managers more control of the amount and timing of emissions. As thinning and first-entry burns were completed, burn windows would expand for larger areas so more burning could occur when ventilation was good. Trees would be more fire resistant, and understory and surface vegetation would become established. With lower surface fuel loading and canopy fuels adapted to fire, burn windows would be broader than for initial entry burns. Decision space for managing unplanned ignitions would expand as Rim Country is implemented.

Fire Type

Once fully implemented, alternative 2 is expected to reduce the potential for active and conditional crown fire to within desired conditions for all vegetation cover types (see table 43 below). Over the Rim Country project area, 11 percent of the area burned under extreme weather conditions would be expected to be active or conditional crown fire, down from 30 percent given existing conditions (figure 67).

Passive crown fire increases slightly (49 percent up from 43 percent EC) under extreme conditions, due to the desired clumpy canopy characteristics of the mechanical treatments. Under less extreme wind conditions (5 mph instead of 20 mph), the majority of the landscape (95 percent) is expected to burn as a surface fire. Maximum reductions in crown fire activity will be achieved following the second re-entry prescribed fire. Following this, crown fire activity may begin to increase unless continued maintenance burning occurs in perpetuity.

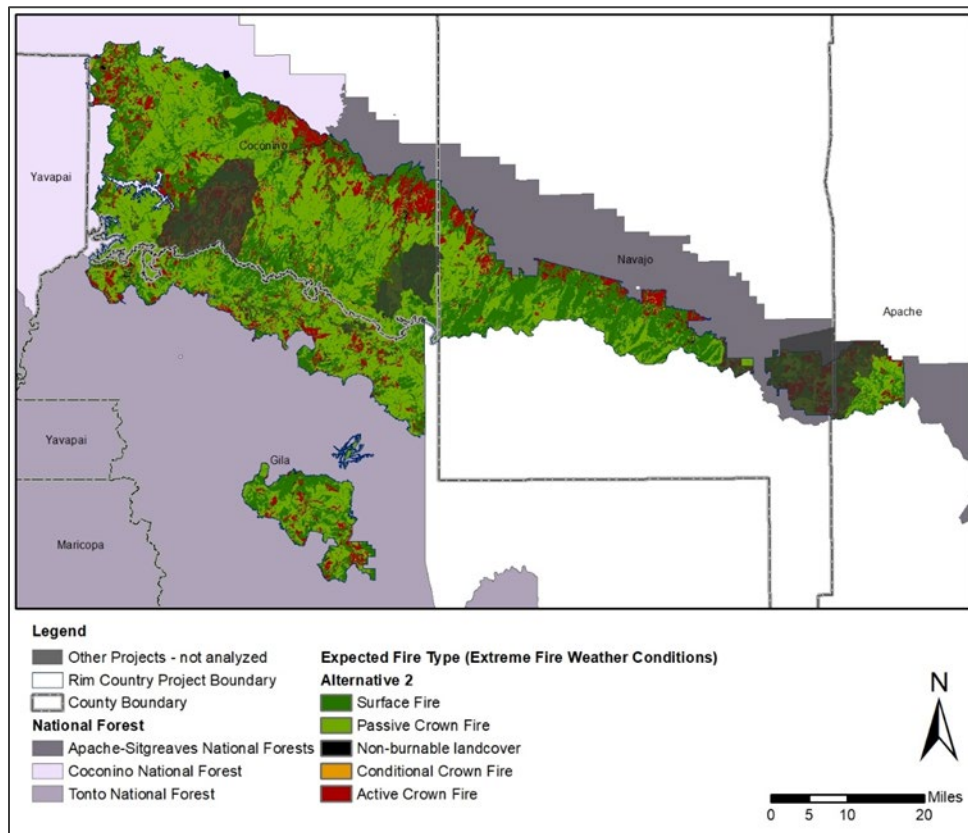


Figure 67. Expected fire type for alternative 2, under modeled weather conditions

Post wildfire watershed effects increase with the percentage of the watershed burns with moderate to high severity fire (Cannon 2010; Neary 2011). Under alternative 2, five watersheds are expected to burn with active crown fire under extreme weather conditions for over 30⁷ percent of the watershed, which would result in moderate to high-severity effects (figure 68). One watershed is expected to exceed 50 percent of the watershed burned with active crown fire. Watershed 56 (Durfee Draw-Chevelon Canyon) has the highest proportion of potential for active crown fire (53 percent). If a large wildfire were to burn within this watershed under extreme fire weather conditions, detrimental post wildfire effects, such as debris flows, would be expected.

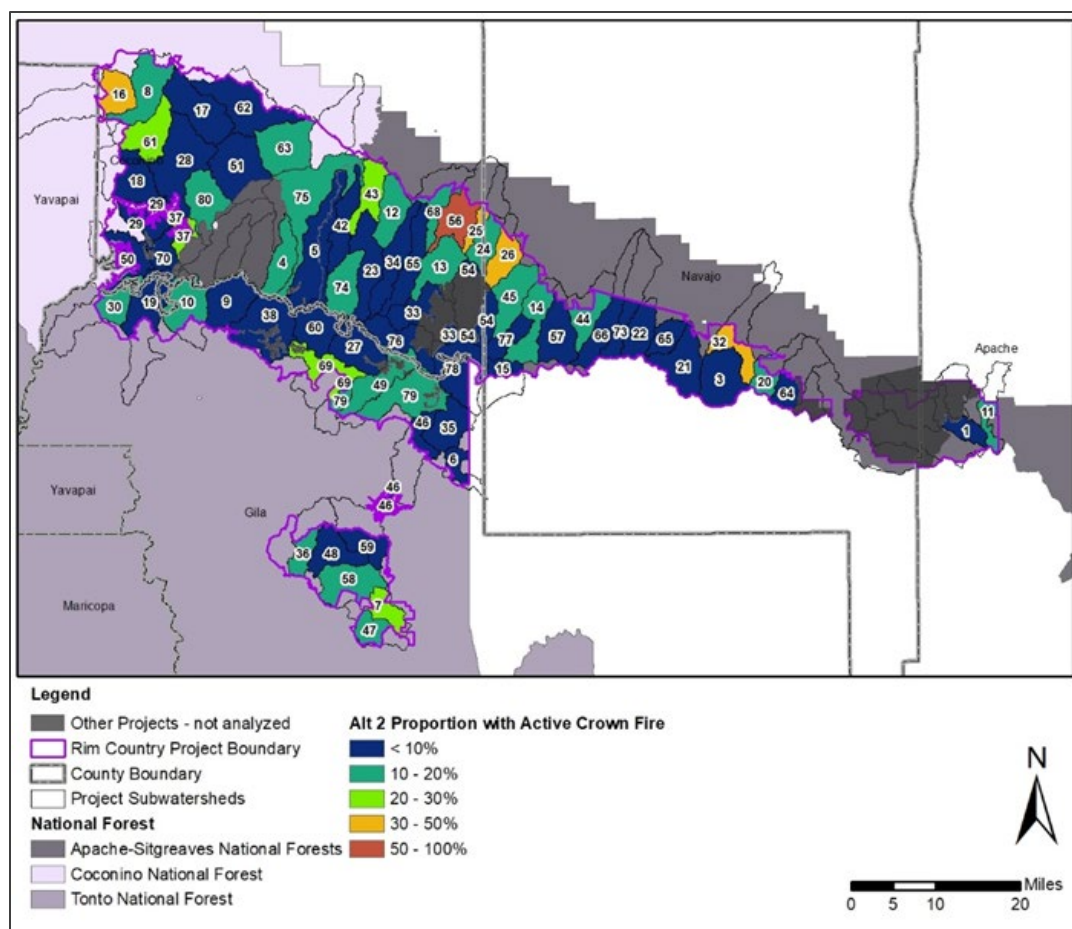


Figure 68. Proportion of each HUC6 watershed with active crown fire for alternative 2, under modeled weather conditions

Fire Hazard Index

Alternative 2 would decrease the risk of undesirable wildfire behavior and effects that could threaten lives, resources, and infrastructure. After implementation, the fire hazard index decreases resulting in 21 percent of the project area is within the moderate to extreme fire hazard index, down from 36 percent in the existing conditions (figure 69). The areas of moderate to extreme fire hazard index presents difficult and dangerous suppression conditions during a wildfire and potential for adverse post fire effects on soils and surface water quality. Maximum reductions in fire hazard index will be achieved following the

⁷ Percentage values are based on National Forest System lands only within a given watershed.

second re-entry prescribed fire. Following this, fire hazard index may begin to increase unless continued maintenance burning occurs in perpetuity.

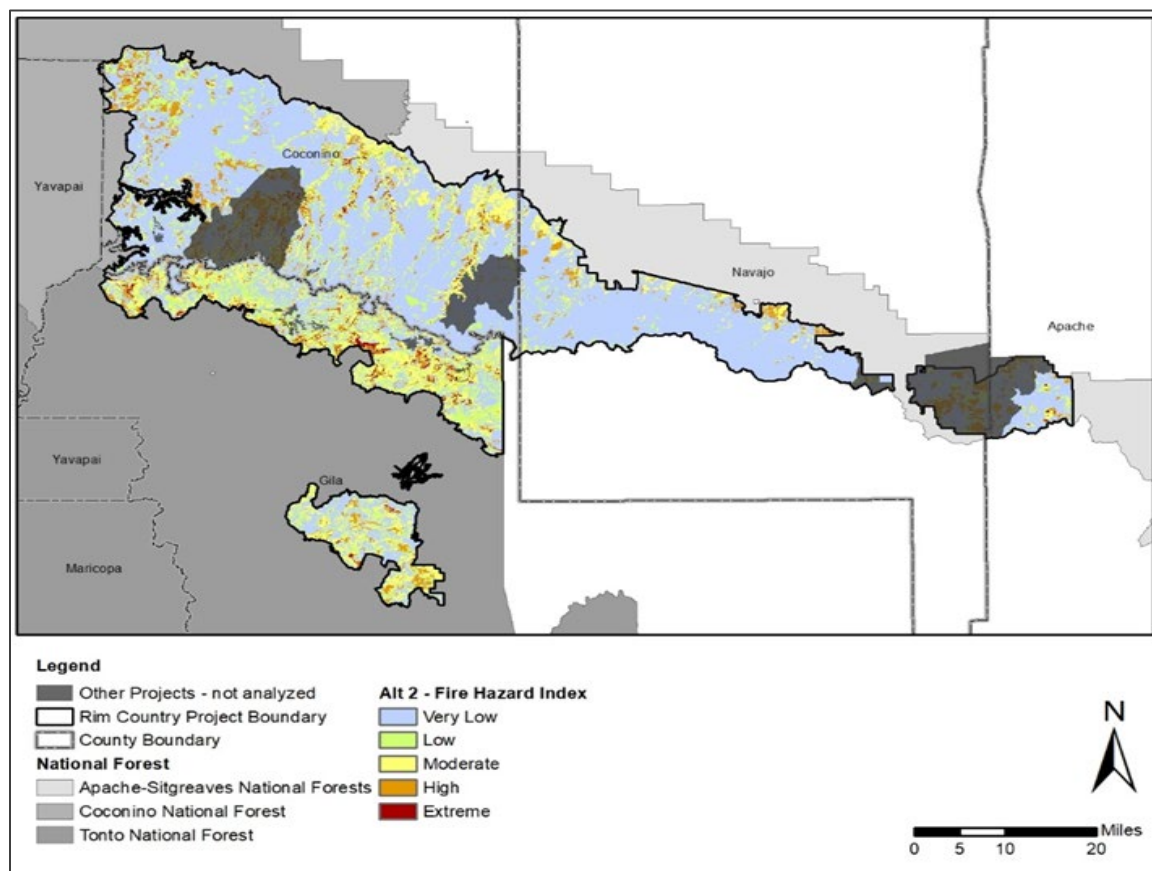


Figure 69. Fire hazard index for alternative 2, under modeled weather conditions

There are 3 watersheds with over 50 percent of the watershed in the moderate to extreme fire hazard index categories (figure 70). Watershed 56 (Durfee Draw-Chevelon Canyon, 55 percent) and 69 (Bull Tank Canyon-Tonto Creek, 51 percent) have the highest proportion of fire hazard index in the moderate to very high class. Large wildfires in these watersheds would still have a high potential to be difficult and dangerous to suppress and have a high potential for adverse post fire effects.

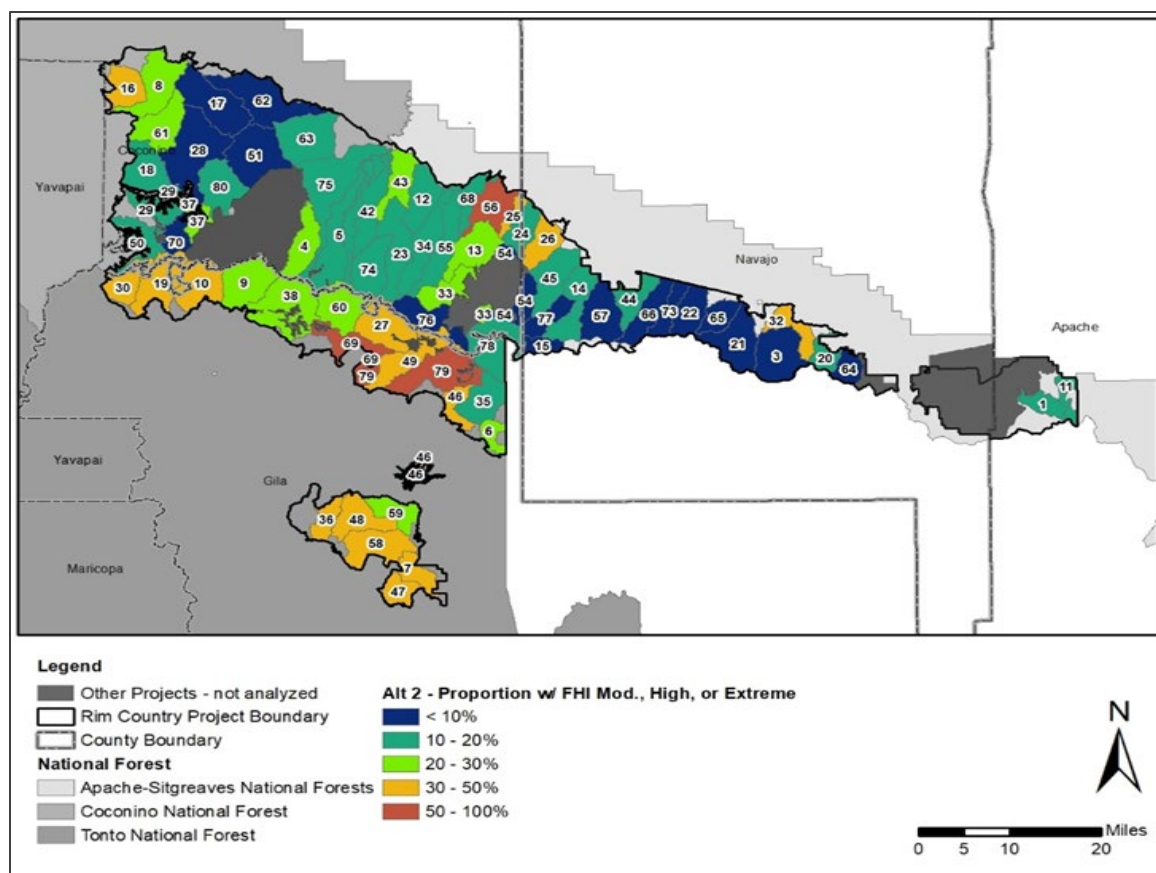


Figure 70. Proportion of each HUC6 watershed with moderate, high or very high fire hazard index for alternative 2, under modeled weather conditions

Surface Fuel Loadings

Under alternative 2, surface fuel loading would initially increase with mechanical treatment. As first and second entry prescribed burns are implemented, these fuel loadings would decrease in most areas except those proposed for Mexican spotted owl treatments, which are designed to maintain a higher level of fuel loading, especially Coarse Woody Debris (dead/down woody fuels greater than 3 inches in diameter).

Desired conditions for total surface fuel loadings are less than 27 tons per acre in Ponderosa Pine vegetation types and less than 30 tons per acre in Dry Mixed Conifer. Under alternative 2, 23,984 acres of Ponderosa Pine (down from 60,023 acres in the existing conditions) and 8,763 acres of Mixed Conifer – Frequent Fire vegetation types (down from 12,262 in the existing conditions) exceed recommended fuel loadings (figure 71). Maximum reductions in surface fuel loading will be achieved following the second re-entry prescribed fire. Following this, surface fuel loading may begin to increase unless continued maintenance burning occurs in perpetuity.

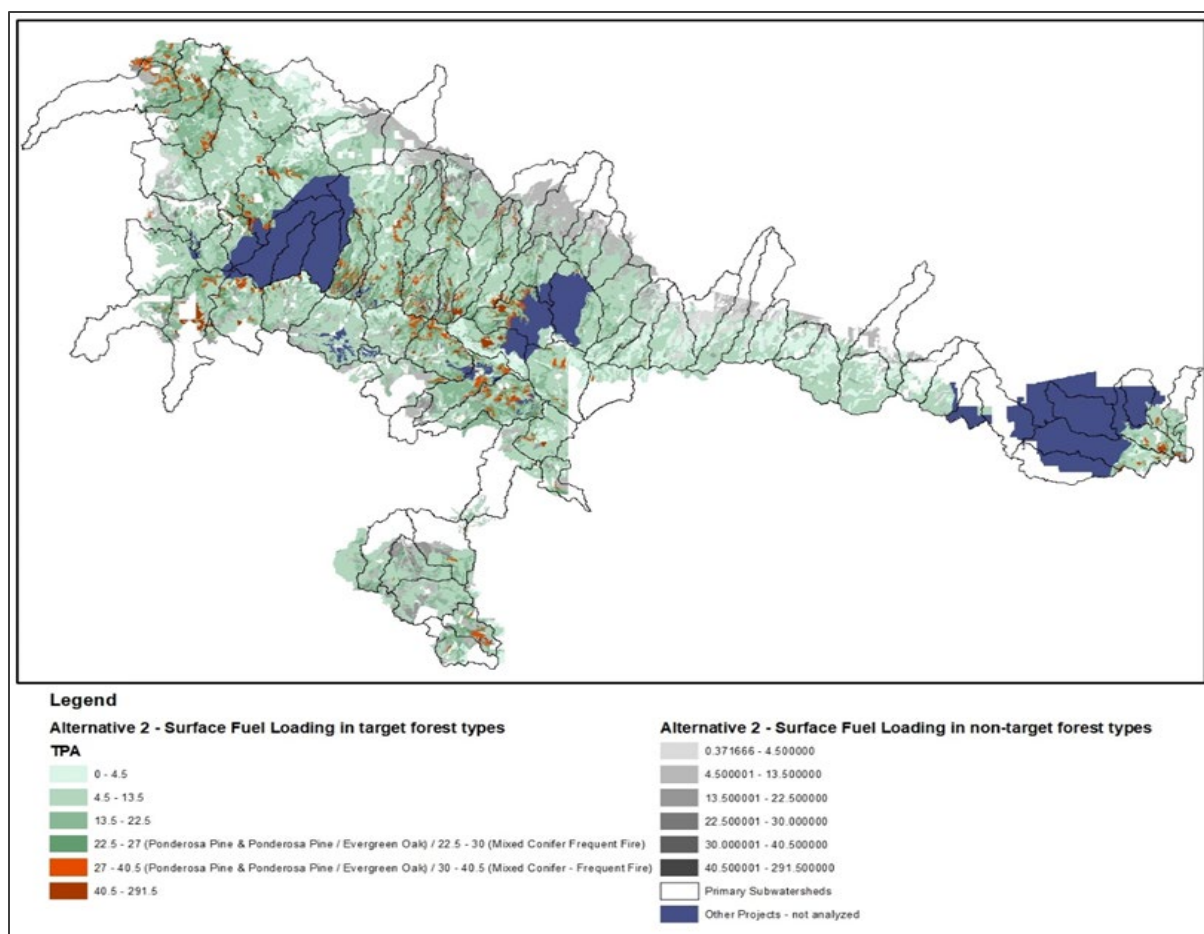


Figure 71. Surface fuel loading in tons per acre for alternative 2, areas in orange and red exceed recommended levels

Effects on Values, Resources and Assets

Wildfire Management

Wildfire management environment would become safer and more effected as both active crown fire (CFA) and fire hazard index decrease. Even under extreme fire weather, suppression tactics would be more effective than current conditions. Decision space for managing unplanned ignitions would expand as Rim Country is implemented.

Wildland Urban Interface

Under the alternative 2, wildland urban interface areas on National Forest System lands across the treatment area would be more fire adapted; however, increasing smoke from prescribed fires would be present next to homes. CFA and fire hazard index both decrease on National Forest System lands (table 42). The potential for home and asset loss from crown fires, high intensity surface fires and ember lofting from fires on National Forest System land would decrease. The need for private and non-forest service landowners to manage fuels on their lands in order to complement Rim Country initiatives would be imperative to fully mitigate risk and impacts from wildfires.

Table 42. Alternative 2 metrics for the wildland urban interface (WUI)

Alternative 2		Fire Hazard Index				Fire Type	
WUI Class	Total Acres	Very Low - Low	Moderate	High	Very High	Passive & Active Crown Fire	Active Crown Fire
Communication Sites	13,333	83%	9%	8%	0%	58%	10%
FS Buildings & Rec Residences	10,548	82%	8%	9%	0%	55%	12%
High Value Rec Sites	5,581	85%	11%	3%	1%	60%	8%
Non FS Land with Structures	144,691	79%	14%	7%	1%	55%	12%
Transmission Lines	28,885	79%	12%	8%	1%	55%	13%

FS – Forest Service

Vegetation Cover Type

At the project scale, active crown fire and fire hazard index are reduced for all target vegetation cover types (table 43). At the project area scale, ponderosa pine would meet desired conditions for active crown fire (less than 10), under alternative 2 even under the extreme conditions modeled.

Table 43. Alternative 2 metrics for vegetation cover type

Vegetation Cover type	Total Acres	Very Low - Low FHI	Moderate FHI	High FHI	Very high FHI	Fire type: Passive & Active Crown Fire	Fire type: Active Crown Fire
Ponderosa Pine	642,198	90%	6%	4%	0%	68%	5%
PIPO Evergreen Oak	148,332	64%	31%	4%	1%	62%	3%
Mixed Conifer – Frequent Fire	52,723	79%	13%	6%	1%	11%	9%
Wet Mixed Conifer with Aspen	4,739	31%	39%	24%	6%	73%	61%
Aspen	1,416	93%	1%	5%	0%	6%	6%
Pinyon Juniper	135,062	49%	33%	16%	2%	51%	47%
Madrean Pinyon Oak	23,056	57%	13%	21%	9%	40%	35%
Grasslands	15,946	97%	1%	1%	0%	16%	2%
Riparian Areas	13,050	76%	17%	5%	1%	34%	8%

Large and Old trees

Under alternative 2, the potential for fire-related mortality of large and/or old trees would be reduced across the landscape. Ignition techniques or other mitigations would be employed to minimize residence time in duff adjacent to old trees whenever possible. Under this alternative, low severity fire would be used in the vicinity of old trees and, to the degree it is practicable, ladder fuels and excessive surface fuel buildups adjacent to old trees would be removed before burning. Scorch is one of the primary factors in large and old tree mortality (Jerman et al. 2004) and is influenced by the vertical arrangement of fuels. Prescribed fire and mechanical treatments in the vicinity of old and/or large trees would decrease fuel loading in the immediate vicinity of these trees, decreasing the potential for crown scorch.

Stream/spring restoration

(Section added from DEIS fire ecology specialist report for consistency)

Restoration of 777 miles of streams and numerous springs would occur inside of existing treatments, with post-treatment conditions meeting desired conditions, but would not be expected to have much effect on fire behavior or effects in the short run. In the long run, restored hydrology in these areas, particularly springs, may result in increased surface fuel loading near springs, allowing wildfire or prescribed fire to creep closer to the water source than is generally possible now. Land management plan direction allows prescribed fire for fuels management riparian areas.

Roads

(Section added from fire ecology specialist report for consistency)

Under this alternative, there would approximately 490 miles of system roads decommissioned, and up to 800 miles of unauthorized roads decommissioned. From 1992 through 2015, over 1,582,239 acres of human-ignited wildfires burned within the ecoregions contained by the Rim Country project area, 35 percent of all acres burned in wildfires (4,456,949 acres). Many wildfires that are started by humans begin in proximity to roads so, under this alternative, there could be fewer human-started wildfires. The more heavily used of these roads have functioned as fire breaks in the past. Once decommissioned, surface fuel loading would eventually grow back, allowing fire to burn across the area. During the implementation of the mechanical treatments, roads improved, constructed, or reconstructed for access (480 miles) would be available for access to burn units, and/or to be used as firelines for burns.

Alternative 3 – Focused Restoration

From a fire ecology perspective, direct and indirect effects of alternative 3 relate primarily to treatments that include mechanical thinning, prescribed fire, or both to meet the purpose and need of the Rim Country. This alternative proposes to conduct about 528,850 acres of restoration activities over about 20 years or until objectives are met. On average, 46,629 acres of vegetation would be mechanically treated annually. On average, 52,885 acres of prescribed fire would be implemented annually across the Forests (within the treatment area).

Direct and Indirect Effects

From a fire ecology perspective, direct and indirect effects of alternative 3 relate primarily to treatments that include mechanical thinning, prescribed fire as described in the section Effects Common to All Action Alternatives, page 229. Areas without treatments will have the indirect effects associated with Alternative 1.

Fire Type

Alternative 3 is expected to reduce the potential for active and conditional crown fire closer to desired conditions for all vegetation cover types (see table 45); however, desired conditions would not be fully attained. Over the Rim Country project area, 18 percent of the area burned under extreme weather conditions would be expected to be active or conditional crown fire, down from 30 percent given existing conditions (figure 72). Passive crown fire increases slightly (53 percent up from 43 percent EC) under extreme conditions, due to the desired clumpy canopy characteristics of the mechanical treatments. Under less extreme wind conditions (5 mph instead of 20 mph), the majority of the landscape would be expected to burn as a surface fire, and only limited acres would be expected to burn with active crown fire. Maximum reductions in crown fire activity will be achieved following the second re-entry prescribed fire. Following this, crown fire activity may begin to increase unless continued maintenance burning occurs in perpetuity.

Post wildfire watershed effects increase with the amount of a watershed that burns at high severity (Cannon 2010; Neary 2011). Under alternative 3, 10 watersheds have expected active crown fire under extreme weather conditions for over 30 percent of the watershed, which would result in high-severity effects (figure 73). Three watersheds have over 50 percent of the watershed expected to burn with active crown fire. Watersheds 59 (Upper Spring Creek) and 56 (Durfee Draw-Chevelon Canyon) have the highest proportion of potential for active crown fire (55 percent and 67 percent respective). If a wildfire were to burn within these watersheds, detrimental post wildfire effects would be expected.

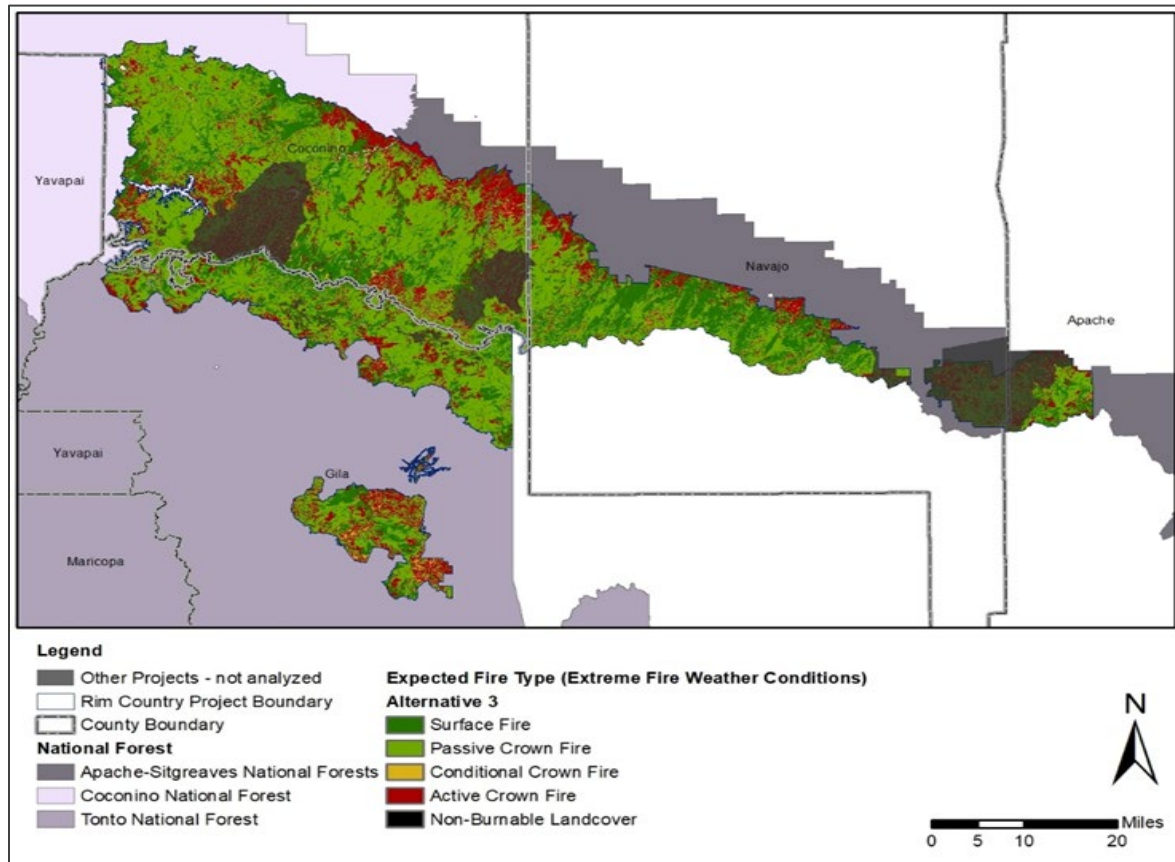


Figure 72. Expected fire type for alternative 3, under modeled weather conditions

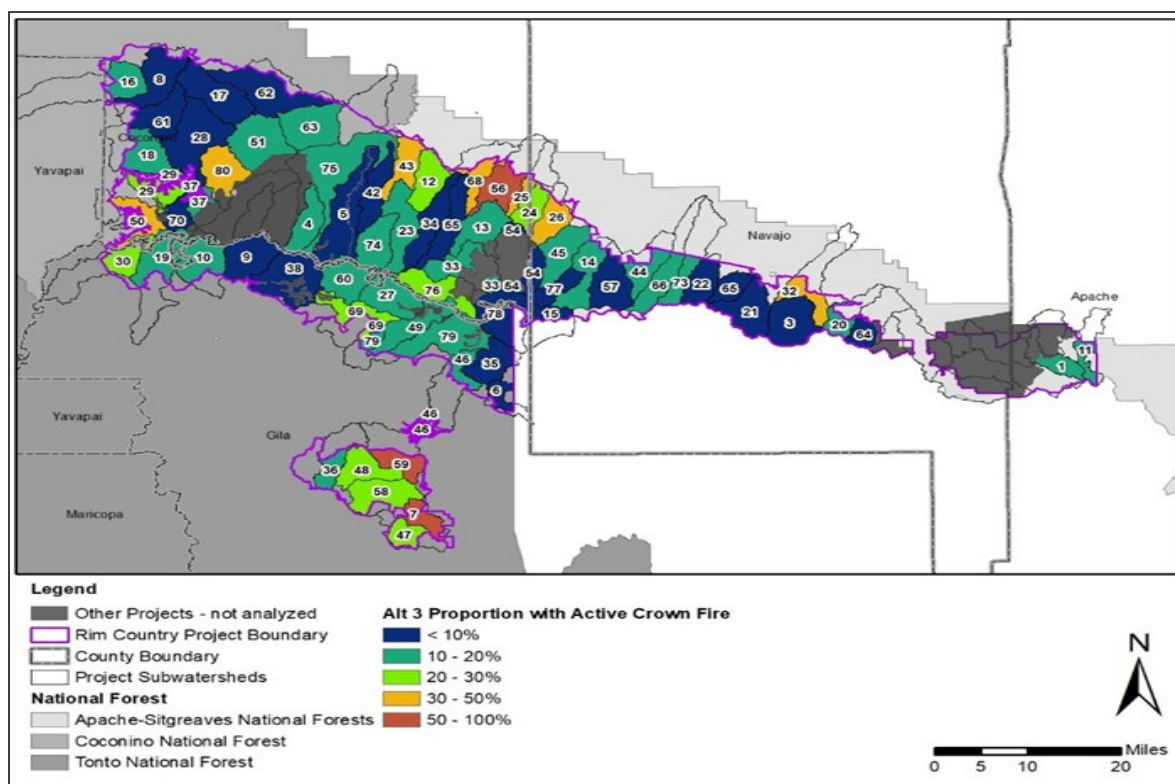


Figure 73. Proportion of each HUC6 watershed with active crown fire for alternative 3, under modeled weather conditions

Fire Hazard Index

Alternative 3 would decrease the risk of undesirable wildfire behavior and effects that could threaten lives, resources, and infrastructure. After implementation, the fire hazard index decreases resulting in 26 percent of the project area is within the moderate to very high fire hazard index (figure 74) down from 36 percent in the existing conditions. The areas of moderate to extreme presents difficult and dangerous suppression conditions during a wildfire and potential for adverse post fire effects on soils and surface water quality. Maximum reductions in fire hazard index will be achieved following the second re-entry prescribed fire. Following this, fire hazard index may begin to increase unless continued maintenance burning occurs in perpetuity.

There are 7 watersheds with over 50 percent of the watershed in the moderate to very high fire hazard index categories (figure 75). Watershed 56 (Durfee Draw-Chevelon Canyon, 63 percent), 7 (Reynolds Creek, 68 percent) and 59 (Upper Spring Creek, 78 percent) have the highest proportion of fire hazard index in the moderate to very high class. Large wildfires in these watersheds have a high potential to be difficult and dangerous to suppress, and have a high potential for adverse post fire effects.

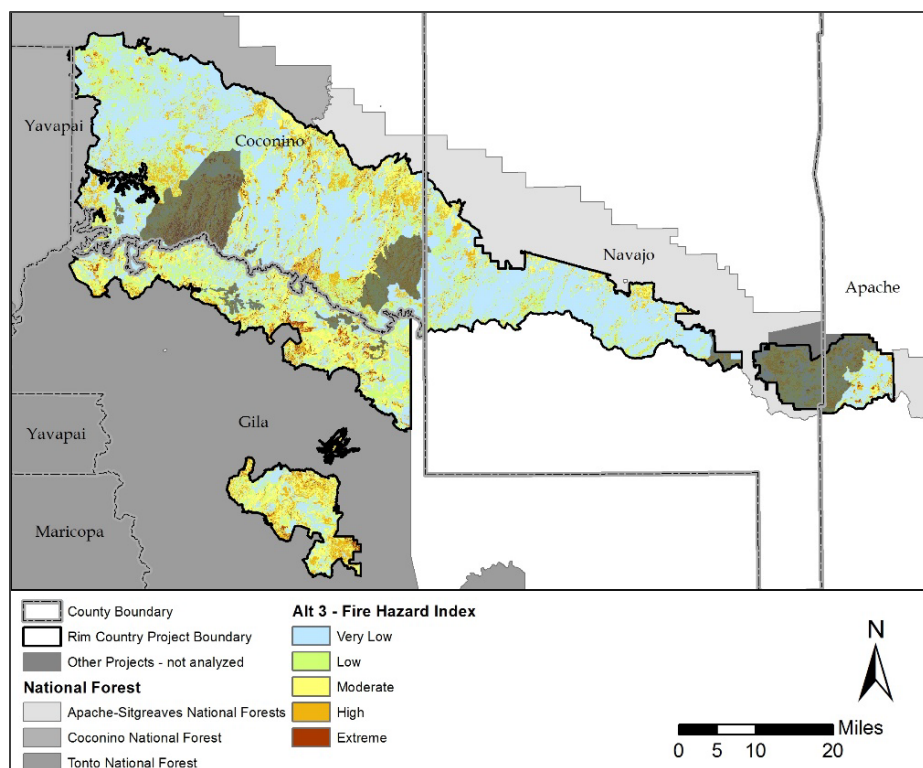


Figure 74. Fire hazard index for alternative 3, under modeled weather conditions

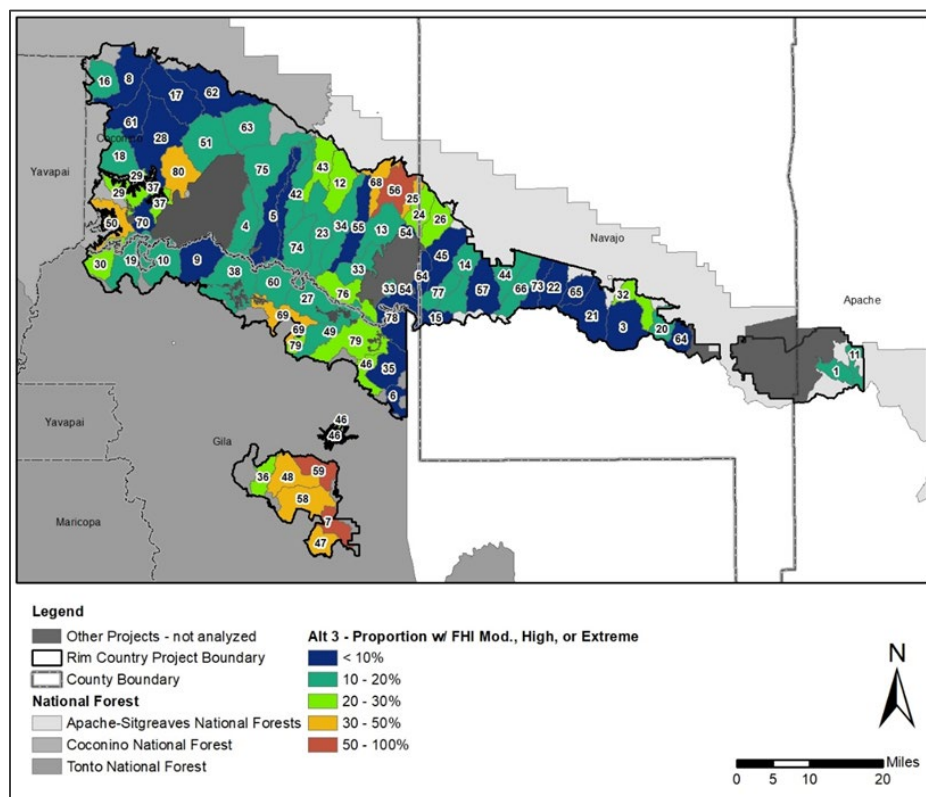


Figure 75. Proportion of each HUC6 watershed with moderate, high or very high fire hazard index for alternative 3, under modeled weather conditions

Surface Fuel Loadings

Under the alternative 3, surface fuel loading would initially increase with mechanical treatment, and would also increase where no treatments occur. As first and second entry prescribed burns are implemented, these fuel loadings would decrease in most areas except those proposed for Mexican spotted owl treatments, which are designed to maintain a higher level of fuel loading, especially Coarse Woody Debris (dead/down woody fuels greater than 3 inches in diameter).

Desired conditions for total surface fuel loadings are less than 27 tons per acre in Ponderosa Pine vegetation types and less than 30 tons per acre in Dry Mixed Conifer. Under alternative 3, 46,894 acres of Ponderosa Pine and 9,846 acres of Dry Mixed Conifer vegetation types exceed recommended fuel loadings. Figure 76 highlights those areas where surface fuel loading is expected to exceed desired conditions under alternative 3. Maximum reductions in surface fuel loading will be achieved following the second re-entry prescribed fire. Following this, surface fuel loading may begin to increase unless continued maintenance burning occurs in perpetuity.

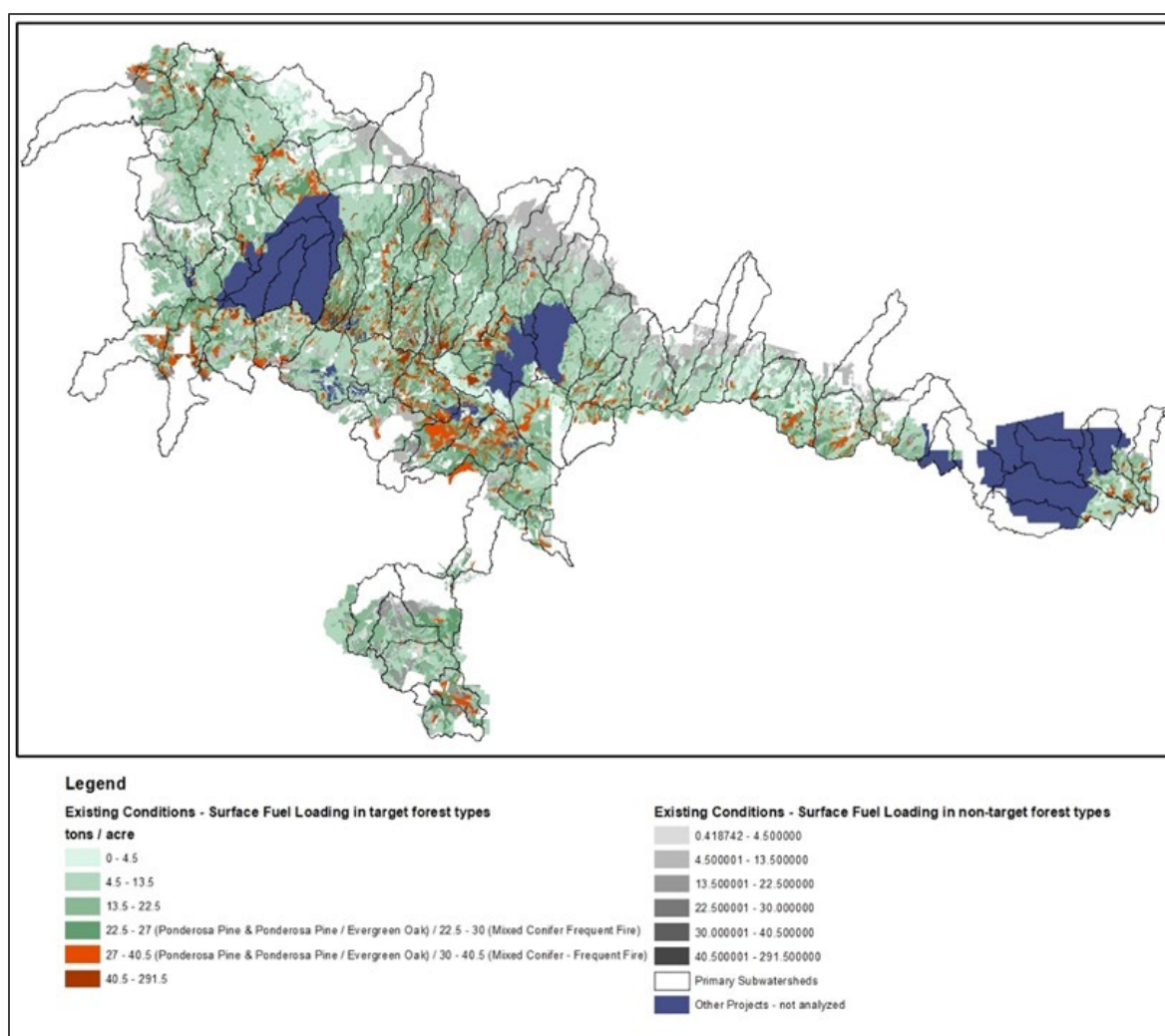


Figure 76. Total surface fuel loadings for alternative 3, under modeled weather conditions

Wildfire Management

Wildfire management environment would become safer and more effected as both CFA and fire hazard index decrease. However, in areas where no treatments are planned, CFA and fire hazard index both increase. Even under extreme fire weather, suppression tactics would be more effective than current conditions. Decision space for managing unplanned ignitions would expand as Rim Country (and other projects) are implemented.

Wildland Urban Interface

Under alternative 3, wildland urban interface areas on National Forest System lands across the treatment area would be more fire adapted; however, increasing smoke from prescribed fires would be present next to homes. CFA and fire hazard index both decrease on National Forest System lands (table 44). The potential for home and asset loss from crown fires, high intensity surface fires and ember lofting from fires on National Forest System land would decrease. The need for private and non-forest service landowners to manage fuels on their lands in order to complement Rim Country initiatives would be imperative to fully mitigate risk and impacts from wildfires.

Table 44. Alternative 3 metrics for the wildland urban interface (WUI)

Alternative 3		Fire Hazard Index				Fire Type	
WUI Class	Total Acres	Very Low - Low	Moderate	High	Very High	Passive & Active Crown Fire	Active Crown Fire
Communication Sites	13,333	77%	10%	11%	1%	70%	16%
FS Buildings & Rec Residences	10,548	76%	9%	14%	2%	68%	17%
High Value Rec Sites	5,581	71%	11%	17%	2%	73%	21%
Non FS Land with Structures	144,691	76%	15%	8%	1%	64%	15%
Transmission Lines	28,885	75%	14%	9%	2%	63%	18%

FS-Forest Service

Vegetation Cover Type

At the project scale, active crown fire and fire hazard index are reduced for all target vegetation cover types (table 45). At the project area scale, ponderosa pine would not meet desired conditions for active crown fire (less than 10 percent), under the extreme conditions modeled. However, individual stands may exceed the desired conditions at the stand scale.

Table 45. Alternative 3 metrics by vegetation cover class

Vegetation Cover type	Total Acres	Very Low - Low FHI	Moderate FHI	High FHI	Very High FHI	Fire type: Passive & Active Crown Fire	Fire type: Active Crown Fire
Ponderosa Pine	642,198	87%	6%	6%	1%	77%	8%
PIPO Evergreen Oak	148,332	54%	34%	10%	2%	73%	11%
Dry Mixed Conifer	52,723	71%	17%	10%	3%	20%	14%
Wet Mixed Conifer	4,739	31%	19%	32%	18%	71%	65%
Aspen	1,416	94%	2%	4%	0%	6%	6%
Pinyon Juniper	135,062	45%	30%	23%	2%	61%	56%
Madrean Pinyon Oak	23,056	34%	22%	33%	10%	68%	61%
Grasslands	15,946	98%	1%	1%	0%	16%	2%
Riparian Areas	13,050	78%	15%	6%	1%	34%	8%

Large and old trees

Under alternative 3, the potential for fire-related mortality of large and/or old trees would be reduced across the landscape where treatments are implemented in the same manner as alternative 2. In areas where no treatments are applied, old trees would respond as in alternative 1.

Stream/spring restoration

(Section added from DEIS fire ecology specialist report for consistency)

Restoration of ephemeral streams, and springs would occur inside of existing treatments, with post-treatment conditions meeting desired conditions, but would not be expected to have much effect on fire behavior or effects in the short run. In the long run, restored hydrology in these areas, particularly springs, may result in increased surface fuel loading near springs, allowing wildfire or prescribed fire to creep closer to the water source than is generally possible now. Land management plan direction allows prescribed fire for fuels management riparian areas.

Roads

(Section added from DEIS fire ecology specialist report for consistency)

From 1992 through 2015, over 1.6 million acres of human ignited wildfires burned on Williams, Tusayan, Flagstaff, and Mogollon Rim Ranger Districts, 35 percent of all acres burned in wildfires (FOA Dataset - Short, 2015). Many wildfires that are started by humans begin in proximity to roads so, under this alternative, there could be fewer human-started wildfires. The more heavily used of these roads have functioned as fire breaks in the past. Once decommissioned, surface fuel loading would eventually grow back, allowing fire to burn across the area. During the implementation of the mechanical treatments, roads constructed or reconstructed for access would be available for access to burn units, and/or to be used as firelines for burns.

Comparison of Alternatives

The effectiveness of the three alternatives for modifying composition, pattern, and structure as a means of restoring healthy ecological function to ponderosa pine, specifically in regard to fire ecology were analyzed. All action alternatives are expected to reset the current trajectory of areas proposed for treatment toward greater sustainability and resilience. Aspen, grasslands, oak communities, and some pinyon/juniper communities associated with ponderosa pine are included. Restoring historic fire regimes

plays both direct and indirect roles in achieving or maintaining desired conditions for these vegetation communities. All action alternatives move the Rim Country proposed treatment area toward desired conditions. Differences between them are discussed below, and summarized at the end of this section.

Fire Type

An overall comparison of fire type across alternatives is presented in figure 77. The change from existing conditions to post-treatment conditions in the action alternatives results primarily from: (1) mechanical treatments breaking up the vertical and horizontal continuity of canopy fuels; (2) mechanical treatments and prescribed fire raising canopy base heights; and (3) prescribed fire consuming surface fuels and some canopy fuels, and decreasing the potential intensity of subsequent fires.

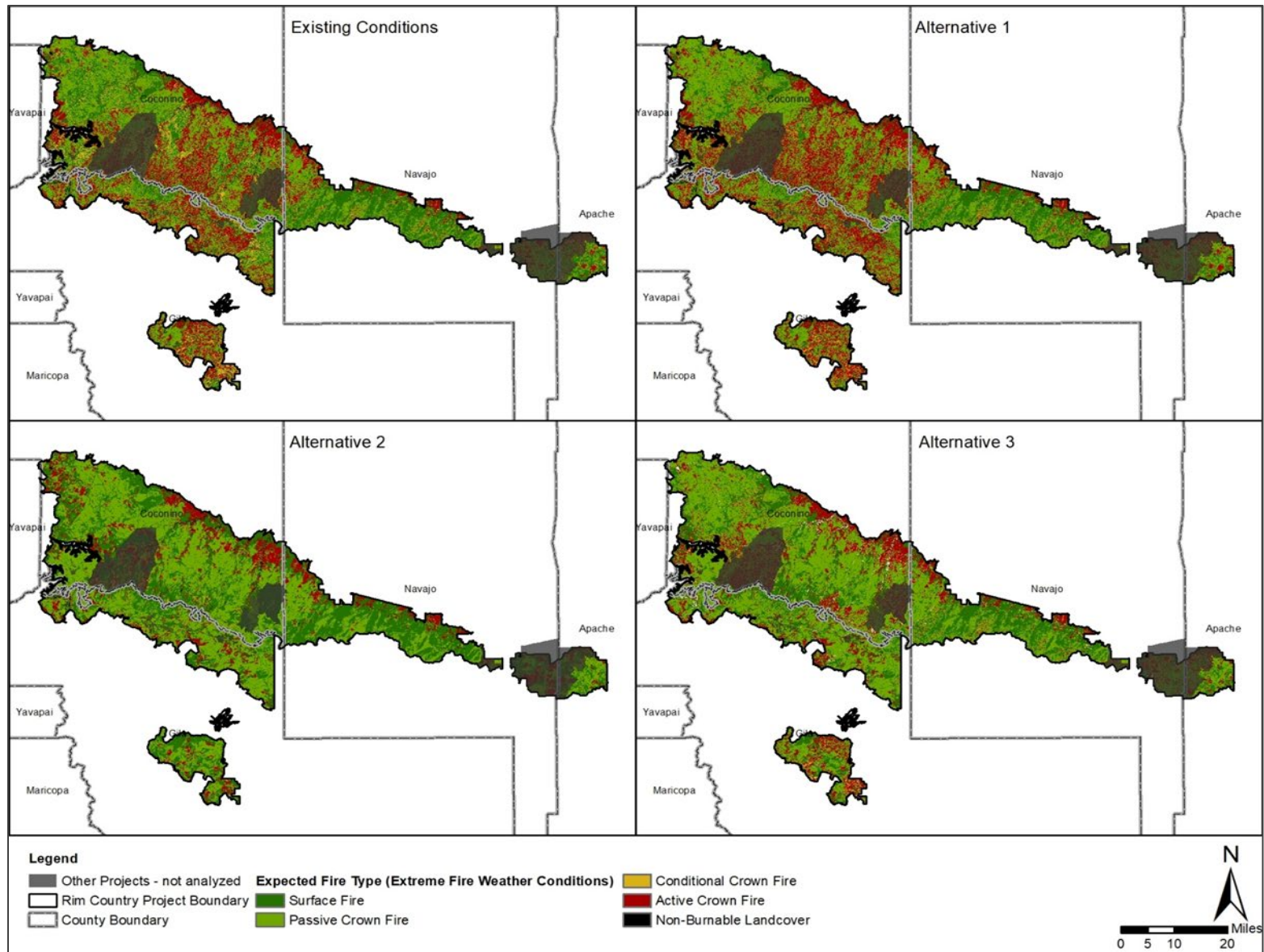


Figure 77. Comparison of fire type for each alternative

Table 46. Comparison of alternatives by fire type within the wildland urban interface (WUI). Increases indicated with an (I) and reductions indicated with a (D) compared to existing conditions (EC).

WUI Class	Total Acres	Fire Type							
		All Crown Fire*				Active Crown Fire*			
		EC	ALT1	ALT2	ALT3	EC	ALT1	ALT2	ALT3
Communication Sites	13,333	75%	81% (I)	58% (D)	70% (D)	26%	28% (I)	10% (D)	16% (D)
FS Buildings & Rec Residences	10,548	76%	83% (I)	55% (D)	68% (D)	31%	33% (I)	12% (D)	17% (D)
High Value Rec Sites	5,581	83%	85% (I)	60% (D)	73% (D)	31%	33% (I)	8% (D)	21% (D)
Non FS Land with Structures	144,691	70%	75% (I)	55% (D)	64% (D)	28%	29% (I)	12% (D)	15% (D)
Transmission Lines	28,885	65%	74% (I)	55% (D)	63% (D)	30%	32% (I)	13% (D)	18% (D)

FS-Forest Service

Table 47. Comparison of alternatives for fire type by vegetation cover class for extreme fire weather. Increases indicated with an (I) and reductions indicated with a (D) compared to existing conditions (EC).

Vegetation Cover Type	Total Acres	Passive & Active Crown Fire: Existing Conditions	Passive & Active Crown Fire: ALT1	Passive & Active Crown Fire: ALT2	Passive & Active Crown Fire: ALT3	Active Crown Fire: Existing Conditions	Active Crown Fire: ALT1	Active Crown Fire: ALT2	Active Crown Fire: ALT3
Ponderosa Pine	642,198	72%	82% (I)	68% (D)	77% (I)	20%	22% (I)	5% (D)	8% (D)
Ponderosa Pine Evergreen Oak	148,332	82%	85% (I)	62% (D)	73% (D)	29%	30% (I)	3% (D)	11% (D)
Dry Mixed Conifer	52,723	75%	77% (I)	11% (D)	20% (D)	50%	54% (I)	9% (D)	14% (D)
Wet Mixed Conifer	4,739	74%	77% (I)	73% (D)	71% (D)	70%	74% (I)	61% (D)	65% (D)
Aspen	1,416	6%	6%	6%	6%	5%	5%	6% (I)	6% (I)
Pinyon Juniper	135,062	71%	71%	51% (D)	61% (D)	65%	67% (I)	47% (D)	56% (D)
Madrean Pinyon Oak	23,056	85%	86% (I)	40% (D)	68% (D)	79%	80% (I)	35% (D)	61% (D)
Grasslands	15,946	15%	16% (I)	16%	16% (I)	2%	2%	2%	2%
Riparian Areas	13,050	45%	49% (I)	34% (D)	34% (D)	17%	19% (I)	8% (D)	8% (D)

Fire Hazard Index

An overall comparison of fire hazard index across alternatives is presented in figure 78. Alternative 1 results in the largest percentage of the project area in the moderate, high and extreme fire hazard index classes. Alternative 2 provides for the largest overall reduction in fire hazard index for the project area as a whole, while alternative 3 shows significant reductions in fire hazard index ratings across much of the project area, though less so than alternative 2.

To further understand the impacts of each proposed alternative based on fire hazard index, it is useful to examine the relative change in fire hazard index rating classes within select areas of interest, especially within wildland urban interface classes. As shown in, table 48 alternative 1 results in a relative increase in the amount of acreage in the high and very high fire hazard index classes across nearly all wildland urban interface classes. Both alternative 2 and alternative 3 show a relative decline in the area of high and very high fire hazard index classes, with a corresponding increase in the area rated as very low-low fire hazard index. This illustrates the effectiveness of both alternatives in reducing the overall fire hazard index rating across all wildland urban interface classes. The differences between alternative 2 and alternative 3 are limited, reflecting the emphasis of treatment in and adjacent to the wildland urban interface areas in both action alternatives. Table 49 provides a further examination of the relative changes in fire hazard index for each vegetation cover type across all alternatives.

Surface Fuel Loading

Total surface fuel loadings is expected to increase under alternative 1, compared with existing conditions. Both alternatives 2 and 3 would reduce total surface fuel loadings, with the biggest reductions occurring under alternative 2 (figure 79).

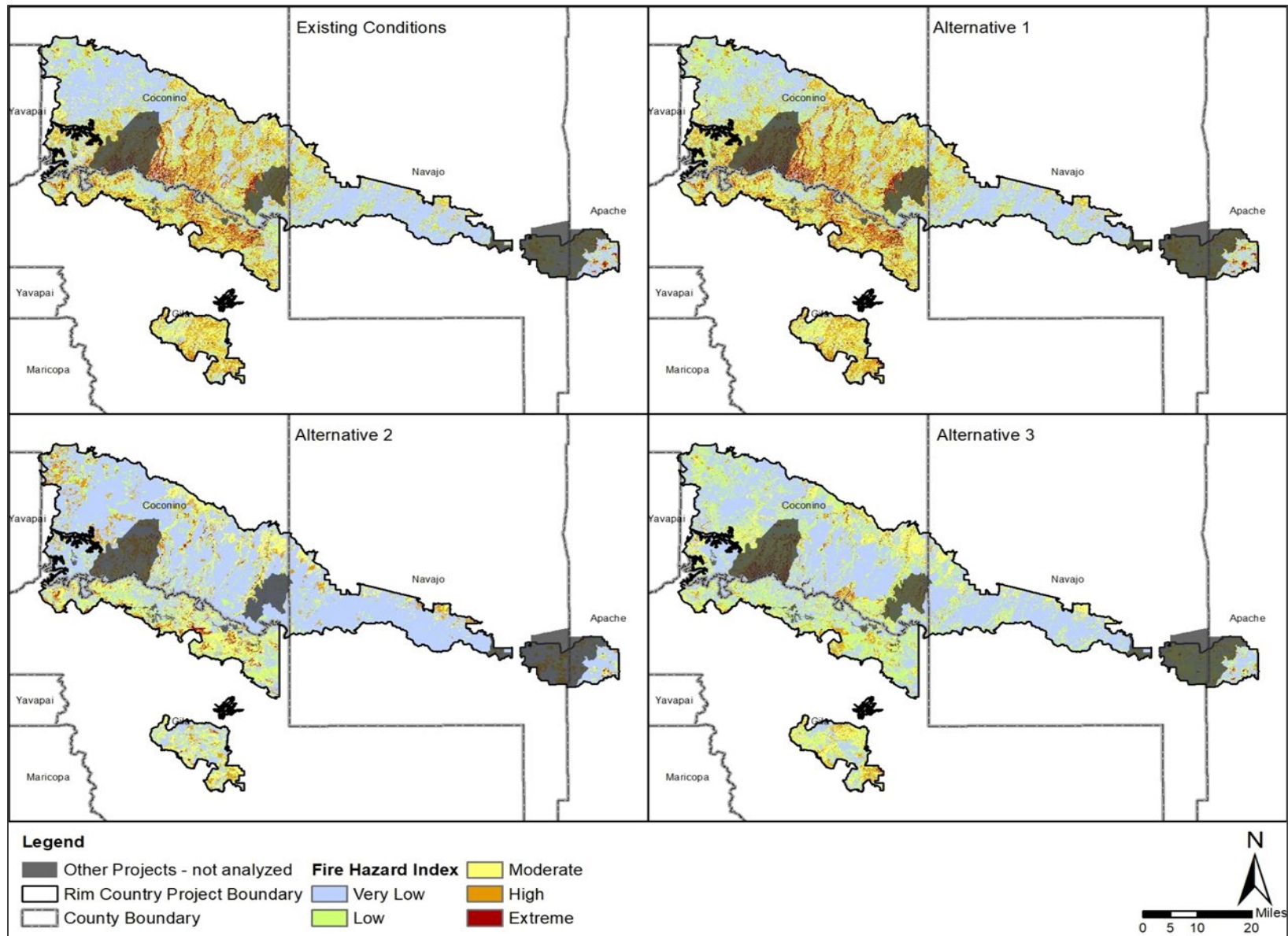


Figure 78. Comparison of fire hazard index between alternatives

Table 48. Comparison of alternatives by fire hazard index for the wildland urban interface (WUI) classes

WUI Class	Total Acres	Very Low - Low				Moderate				High				Very High			
		ECs	Alt1	Alt2	Alt3	ECs	Alt1	Alt2	Alt3	ECs	Alt1	Alt2	Alt3	ECs	Alt1	Alt2	Alt3
Communication Sites	13,333	67%	64%	83%	77%	13%	14%	9%	10%	18%	19%	8%	11%	2%	3%	0%	1%
FS Buildings & Rec Residences	10,548	62%	60%	82%	76%	11%	11%	8%	9%	21%	23%	9%	14%	5%	6%	0%	2%
High Value Rec Sites	5,581	64%	61%	85%	71%	9%	9%	11%	11%	21%	22%	3%	17%	7%	8%	1%	2%
Non FS Land with Structures	144,691	66%	63%	79%	76%	16%	16%	14%	15%	16%	18%	7%	8%	3%	3%	1%	1%
Transmission Lines	28,885	66%	63%	79%	75%	16%	15%	12%	14%	15%	17%	8%	9%	3%	4%	1%	2%

FS – Forest Service

Table 49. Comparison of alternatives for fire hazard index ratings

Vegetation Cover Type	Total Acres	Very Low - Low FHI				Moderate FHI				High FHI				Very High FHI			
		ECs	Alt1	Alt2	Alt3	ECs	Alt1	Alt2	Alt3	ECs	Alt1	Alt2	Alt3	ECs	Alt1	Alt2	Alt3
Ponderosa Pine	642,198	78%	75%	90%	87%	8%	7%	6%	6%	12%	16%	4%	6%	2%	2%	0%	1%
Ponderosa Pine/Evergreen Oak	148,332	41%	36%	64%	54%	30%	33%	31%	34%	24%	26%	4%	10%	4%	5%	1%	2%
Mixed Conifer/Frequent Fire	52,723	30%	26%	79%	71%	18%	18%	13%	17%	27%	29%	6%	10%	24%	27%	1%	3%
Mixed Conifer with Aspen	4,739	28%	24%	31%	31%	7%	7%	39%	19%	30%	32%	24%	32%	34%	37%	6%	18%
Aspen	1,416	91%	91%	93%	94%	1%	1%	1%	1%	4%	5%	5%	4%	3%	3%	0%	0%
Pinyon-Juniper Woodland	135,062	38%	37%	49%	45%	33%	32%	33%	30%	26%	28%	16%	23%	2%	3%	2%	2%
Madrean Pinyon-Oak	23,056	20%	19%	57%	34%	32%	33%	13%	22%	42%	41%	21%	33%	6%	7%	9%	10%
Grassland/Meadow	15,946	98%	98%	97%	98%	1%	1%	1%	1%	0%	0%	1%	1%	0%	0%	0%	0%
Riparian	13,050	73%	71%	76%	78%	11%	11%	17%	15%	11%	13%	5%	6%	4%	5%	1%	1%

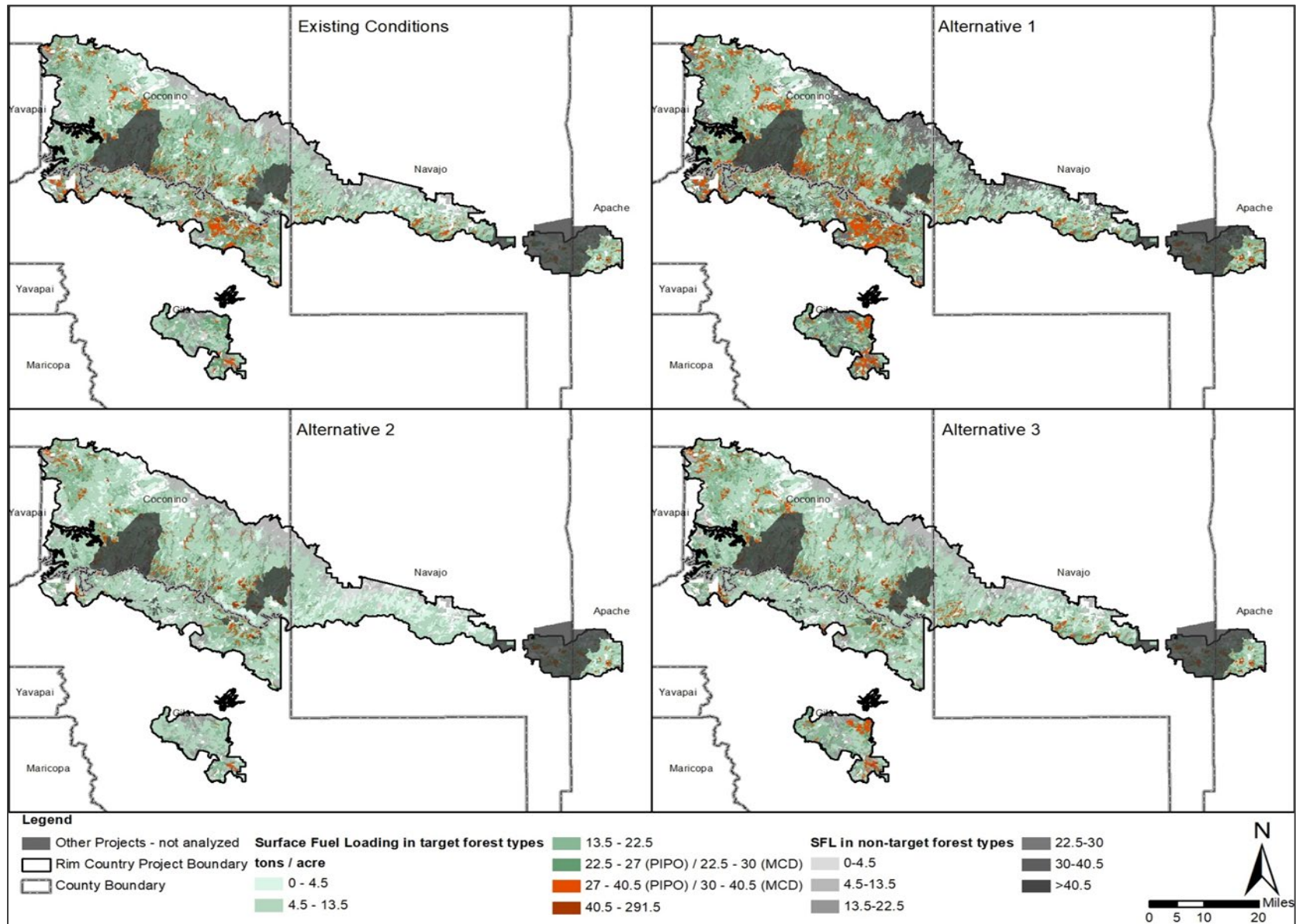


Figure 79. Comparison of total surface fuel loading

Cumulative Effects

Cumulative effects related to fire ecology and air quality are incremental impacts of an alternative when added to the effects of other past, present, and reasonably foreseeable future actions. These include the effects of wildfire and vegetation management activities (mechanical treatments and prescribed fire) on fire behavior and associated fire effects, including air quality.

Geographic Scope - Cumulative effects of wildfires and other projects are considered for the approximately 1.24-million-acre Rim Country project area.

Temporal Scope - This analysis primarily considered the past 10 years of associated activities. This time period is based on recovery times and fuel accumulation rates associated with the ecological systems present in the Rim Country area. This analysis considered a 20-year time frame to reflect future and reasonably foreseeable activities at which time the majority of the actions proposed will have been completed.

Past Actions

Wildfire

Nearly all area of the cumulative effects analysis area has been influenced or altered by past modifications to natural fire regimes as a result of fire suppression and livestock grazing. The culmination of these impacts over more than a century has resulted in the contemporary conditions found throughout the Rim Country project area. While the primary focus of this cumulative effects analysis focusses on the previous 10 years of wildfires and activities, it is important to note the role that past management has had on influencing this landscape and creating undesirable and unnatural conditions.

From 2009 to 2018, 81 large wildfires⁸ burned within the project area, representing a total of 217,780 acres burned (figure 80). Many of the wildfires that burned within the project area in the last 10 years were managed primarily for beneficial resource objectives (as opposed to being managed primarily for suppression objectives). These accounted for 38 wildfires totaling 126,310 acres burned within the project area. Other fires may have had some resource benefit management objectives as well, however the information needed to assess this is not readily available. The fire severity of the 38 wildfires managed primarily for resource benefit was mostly low and moderate.

⁸ The Forest Service and the National Interagency Fire Center define 'large fires' as fires of at least 300 acres in size for grass or shrub fuels, or at least 100 acres in size in timber fuels (USDA 2014a). This analysis includes all fires that occurred from 2009 through 2018 and were at least 100 acres in size.

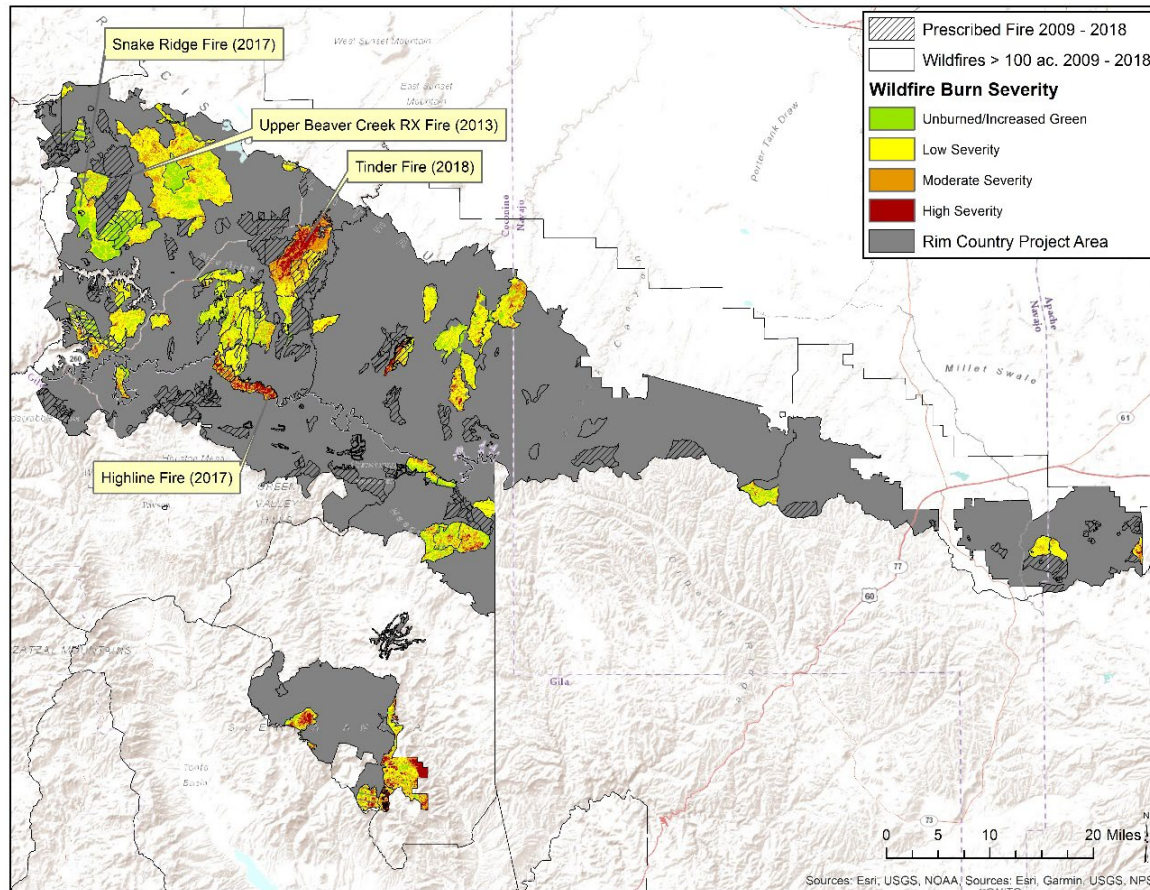


Figure 80: Recent wildfire and prescribed fire (2009 to 2018) and the associated wildfire burn severity

However, high-severity fire has continued to occur within the Rim Country area. In the past 10 years, approximately 12,193 acres burned at high severity within the project area. The Tinder Fire (managed for suppression) burned with 27 percent (4,328 acres) high severity, and 33 homes were destroyed. The Highline Fire (also managed for suppression) burned with 18 percent high severity. Post fire debris flows initiated in part from the Highline Fire claimed the lives of 10 people and caused significant damage to the watershed. These fires demonstrate some of the negative impacts associated with high-severity fires.

Vegetation Management Activities

Within the cumulative effects analysis area, there were approximately 164,232 acres of mechanical thinning and approximately 259,661 acres of prescribed fire acres within the past 10 years (table 50).

These past activities have, and will continue to moderate potential wildfire effects for the cumulative effects analysis area. This was demonstrated by the Upper Beaver Creek prescribed fires completed in 2013. These treatments allowed for the 2017 Snake Ridge wildfire to be managed for beneficial resource objectives, and influenced the final fire perimeter. Objectives of these projects include fuels reduction, maintenance burning, recreating historic stand conditions in PJ (mixed severity), and reducing the risk of stand replacement fire and the rate of spread, intensity, and severity of wildfires that do occur.

Table 50. Acres of past, present and reasonably foreseeable projects with cumulative effects for fire, fuels and air quality

Treatment Type	Past Projects (approximate acres)	Current Projects (approximate acres)	Reasonably Foreseeable Projects (approximate acres)	Combined Past, Present and Reasonably Foreseeable Projects (approximate acres)
Mechanical Vegetation Management	164,232	417,551	124,434	706,217
Prescribed Fire	259,661	383,541	64,710	707,912
Other Activities*	51,072	40,379	93,147	184,598
Totals	474,965	841,471	282,291	1,598,727

*Other activities include but not limited to fuels chipping, range forage improvement or manipulation, range vegetation control, wildlife habitat improvement, tree encroachment control, tree release, fuels compaction, special products removal, insect control and prevention planting, fuel break creation, cultural site protection, scarification and seeding, pruning, and salvage.

In general, the past management actions have decreased the potential for active crown fire, crown fire initiation and high-severity fire effects on the acres treated and/or burned by wildfire. Across the cumulative effects analysis area other projects have affected vegetation in similar ways to those described under this project's alternatives, though there are some variations in treatments, particularly for the older fuels treatments. Past mechanical and prescribed fire treatments have decreased the potential for crown fire by breaking up the vertical and horizontal continuity of canopy fuels. Prescribed fire and low severity wildfires further decreased the potential for crown fire, by removing additional ladder fuels, decreasing canopy bulk density, and raising canopy base height. Maintenance burning and wildfires decreased surface fuel loading in most areas burned, decreasing the potential intensity of subsequent fires in those locations.

Present and Reasonably Foreseeable Actions

Current, ongoing, and foreseeable projects within the Rim Country project area include 448,251 acres of prescribed fire and 541,985 acres of mechanical vegetation management (table 28). Some of these projects are in the early stages of proposal development or are presently on hold, so their implementation is reasonably foreseeable but not assured. The acreages shown under mechanical vegetation management and fuels treatments are not all mutually exclusive. There are many acres on which proposed fuels treatments (mechanical and prescribed fire) overlap with proposed mechanical vegetation management treatments.

Alternative 1 – No Action

Effects of the Alternative

Alternative 1 would continue to maintain 977,656 acres with increasing potential for high-severity fire effects and behavior, though the effects would be mitigated to some degree by current and reasonably foreseeable projects, and any beneficial wildfires that may occur in the future. Alternative 1 would not contribute to improving the structure, composition, and patterns within the area proposed for treatment.

Effects of Other Actions

Fuel treatments have been and continue to be implemented in wildland urban interface closest to major population centers, but much of the landscape is still vulnerable to undesirable fire behavior and effects, including changes in site productivity, loss of critical habitat, flooding, erosion, weed infestations, damaged infrastructure, and the longer term effects of having thousands of acres of dead trees nearby for decades.

Within the area considered for cumulative effects for fire ecology and air quality, other actions will contribute to some improvement in landscape conditions. However, these improvements would be much less than those predicted for the action alternatives. Improvements would be primarily localized, within individual project boundaries, and collectively do less to move the broader landscape toward desired conditions. Alternative 1 would lead to less spatial continuity between treatments when compared to the action alternatives. At the landscape scale, it would not put the ponderosa pine and associated vegetative systems on trajectories toward being resilient or sustainable.

Cumulative Effects

Under alternative 1, the treatment area would continue develop unnatural densities and fuel loading, increasing the potential for undesirable fire behavior and effects when wildfires occur. When fires did occur, many would have potential for extreme fire behavior and could produce large areas of high-severity fire effects. These impacts could extend well outside of the treatment area as fires that start within the proposed treatment area may pose difficulties for control and spread to adjacent lands. Many fires starting within the untreated project area would have potential to spread outside of the treatment area. Increased potential for extreme fire behavior would put lives, property, infrastructure, and natural resources at risk. Effects would also extend well beyond the perimeters of the fire, and would include such effects as flooding, debris flow, sedimentation, decreased water quality and quantity, decreased soil productivity, and other effects of fires burning out of their natural range of variation.

Fire Type

For those areas treated under the past, present, and reasonably foreseeable actions, there would be a decrease in potential crown fire. However, the majority of the landscape would remain susceptible to crown fire and associated fire-related impacts under alternative 1.

Fire Hazard Index

Similar to fire type, reductions in fire hazard index are anticipated for areas treated under past, present and reasonably foreseeable actions. While beneficial, these reductions are not sufficient to mitigate the high fire hazard index ratings across the majority of the landscape.

Surface Fuels

Some reductions in surface fuels are anticipated, associated with the areas treated by past, present and reasonably foreseeable actions. However, for much of the cumulative effects analysis area, unnatural levels of surface fuels will continue to build up. When wildfires do occur in these areas of increased surface fuels, additional consumption and associated emissions are expected.

Alternative 2 – Modified Proposed Action

Effects of the Alternative

As described in the direct and indirect effects section, treatments proposed in alternative 2 would move considerable acres toward desired conditions for fire behavior and associated fire effects across the project area.

Effects of Other Actions

Fuel treatments have been and continue to be implemented in the wildland urban interface, closest to major population centers.

Within the area considered for cumulative effects for fire ecology and air quality, other actions will contribute to improvements in landscape conditions. Improvements include localized reductions in crown fire potential, decreases in fire hazard index values, and reduced levels of surface fuels.

Cumulative Effects

When considered with past wildfires, and past, ongoing, and reasonably foreseeable management activities, this alternative would augment the effects of proposed treatments at multiple scales, creating mosaics of potential fire behavior and effects, dominated by low severity fire. The proposed treatments would fill in most of the acres between past, current, ongoing, and foreseeable management activities, creating a more cohesive, contiguous, restored landscape across the project area.

Where past, present and foreseeable wildfires and treatments occur close to treatments proposed in the action alternatives, they serve to augment the moderating effect that the change in fuel structure is predicted to have on wildfires moving through the area by decreasing the acres where high-severity fire effects are likely to occur. These combined activities also serve to augment the potential size and locations of burn units for the action alternatives because the moderated fire behavior in burned and/or thinned areas allow prescribed fire to be implemented with broader burn windows and higher intensity fire (if desired) while still meeting control and resource objectives.

Fire Type

Alternative 2 reduces crown fire potential under extreme fire weather conditions from 31 percent under current conditions to 12 percent within areas proposed for treatment. This reduction, combined with the past, ongoing, and reasonably foreseeable management activities would cumulatively reduce the overall landscape susceptibility to crown fire. When added to other treatments in the cumulative effects area alternative 2 provides for greater connectivity of treated landscapes resulting and the largest overall reduction in crown fire potential as contrasted with alternative 3. As a result, under moderate burning conditions, the majority of the landscape is projected to support surface fire. These cumulative effects provide the biggest improvement of all alternatives in overall firefighter and public safety while allowing fire to play a more natural role across the landscape and provide opportunities to manage fires for resource benefits across a broader landscape.

Fire Hazard Index

This alternative provides for a significant reduction in moderate to extreme fire hazard index (FHI) ratings, reducing the total area in these categories to 21 percent of the project area from 36 percent. When combined with past, ongoing, and reasonably foreseeable management activities, this alternative provides for additional improvements in fire hazard index over the full cumulative effects analysis area.

Surface Fuels

Cumulative effects on surface fuels under alternative 2 provide for the greatest overall reduction in surface fuels. Cumulatively, this alternative will lead to a reduction in unnatural levels of surface fuels that have built up over time. When wildfires do occur in these areas of reduced surface fuels, consumption and associated emissions are expected to be lower than they would have been without the combined treatments.

Alternative 3 – Focused Restoration

Effects of the Alternative

As described in the direct and indirect effects section, treatments proposed in alternative 3 would move considerable acres toward desired conditions for fire behavior and associated fire effects across the project area.

Effects of Other Actions

Fuel treatments have been and continue to be implemented in the wildland urban interface, closest to major population centers. Within the area considered for cumulative effects for fire ecology and air quality, other actions will contribute to improvements in landscape conditions. Improvements include localized reductions in crown fire potential, decreases in fire hazard index values, and reduced levels of surface fuels.

Cumulative Effects

Fire Type

Alternative 3 reduces crown fire potential under extreme fire weather conditions from 30 percent under current conditions to 18 percent within areas proposed for treatment. This reduction, when combined with the past, ongoing, and reasonably foreseeable management activities will serve to reduce the overall landscape susceptibility to crown fire. Cumulatively alternative 3 when combined with prescribed fire from other projects provides for less connectivity of treated landscapes, though portions of areas not proposed for treatment remain susceptible to crown fire. As with alternative 2, under moderate burning conditions, the majority of the landscape is projected to support surface fire. The cumulative effects will improve overall firefighter and public safety while allowing fire to play a more natural role across the landscape and provide opportunities to manage fires for resource benefits across a broader landscape, though to a lesser degree than alternative 2.

Fire Hazard Index

This alternative provides for a significant reduction in moderate to extreme fire hazard index ratings, reducing the total area in these categories to 26 percent of the project area from 36 percent. When combined with past, ongoing, and reasonably foreseeable management activities, this alternative provides for additional improvements in fire hazard index over the cumulative effects analysis area.

Surface Fuels

Cumulative effects on surface fuels under alternative 3 provide for considerable reduction in surface fuels. Cumulatively, this alternative would lead to a reduction in unnatural levels of surface fuels that have built up over time. However, areas left untreated would continue to accumulate unnatural fuel loading, and when wildfires do occur in these areas, elevated consumption and associated emissions are expected.

Noxious and Invasive Weeds

Affected Environment

Each of the three forests has separate noxious or invasive weed treatment analyses. As a result, the targeted species and treatment methods may differ across forests. The Coconino National Forest was the first of the three forests to complete a noxious or invasive weed treatment analysis the *Final*

Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds, Coconino, Kaibab, and Prescott National Forests; (USDA Forest Service 2005b), analyzing 29 species for treatment. The Apache-Sitgreaves National Forests completed the *Environmental Assessment for the A-SNFs Integrated Forest-Wide Noxious or Invasive Weed Management Program* (USDA Forest Service 2008). It analyzed 53 species and included a variety of treatments including chemical, cultural, mechanical/physical and biological control. The Tonto National Forest completed the *Environmental Assessment for Integrated Treatment of Noxious or Invasive Plants* in 2012 (USDA FS 2012f) and addressed 68 species. It includes manual, mechanical, prescribed burning, cultural, use of biological control agents, and use of herbicides.

Noxious or invasive weeds are present within all three forests in the project area.

Table 51. Noxious or invasive weeds within the project boundary and forest where each species occurs

Scientific name	Common name	Forest
<i>Acroptilon repens</i>	Russian knapweed	Apache-Sitgreaves, Coconino, Tonto
<i>Alhagi maurorum</i>	camelthorn	Coconino, Tonto
<i>Arundo donax</i>	Giant reed	Tonto
<i>Bothriochloa ischaemum</i>	yellow bluestem	Coconino
<i>Brassica tournefortii</i>	Asian mustard	Tonto
<i>Bromus arvensis</i> (<i>B. japonicus</i>)	Japanese brome	Coconino, Tonto
<i>Bromus rubens</i>	Red brome	Tonto
<i>Bromus tectorum</i>	cheatgrass	Coconino, Tonto
<i>Carduus nutans</i>	musk thistle	Apache-Sitgreaves, Coconino, Tonto
<i>Centaurea biebersteinii</i>	spotted knapweed	Coconino
<i>Centaurea diffusa</i>	Diffuse knapweed	Coconino
<i>Centaurea melitensis</i>	Malta starthistle	Tonto
<i>Centaurea solstitialis</i>	yellow star-thistle	Apache-Sitgreaves, Coconino, Tonto
<i>Convolvulus arvensis</i>	Field bindweed	Tonto
<i>Eragrostis curvula</i>	Weeping lovegrass	Tonto
<i>Eragrostis lehmanniana</i>	Lehmann's lovegrass	Tonto
<i>Cirsium vulgare</i>	bull thistle	Apache-Sitgreaves, Coconino, Tonto
<i>Eleagnus angustifolia</i>	Russian olive	Coconino
<i>Erysimum repandum</i>	Spreading wallflower	Tonto
<i>Euphorbia esula</i>	Leafy spurge	Coconino
<i>Linaria dalmatica</i>	Dalmatian toadflax	Coconino, Tonto
<i>Linaria vulgaris</i>	butter and eggs	Apache-Sitgreaves
<i>Onopordum acanthium</i>	Scotch thistle	Coconino, Tonto
<i>Tamarix ramosissima</i>	salt cedar	Apache-Sitgreaves, Coconino, Tonto
<i>Ulmus pumila</i>	Siberian elm	Tonto

Assumptions

This analysis is based on the following assumptions.

- All management activities would occur as analyzed in the various specialists reports and described in the FEIS.
- The mitigation measures, design features, and best management practices would be incorporated into project design and implementation. See appendix C of FEIS.

- Areas to be treated would be surveyed for noxious or invasive weeds before treatments are implemented. These factors should be considered when identifying survey needs:
 - Likelihood of any of the species addressed in the botany and weeds specialist report occurring within the treatment area
 - Amount of disturbance. For example, surveys may not be needed in areas scheduled for prescribed burning if the treatments are scheduled to be of low intensity.
- The acreage of potential disturbance in this project is much larger than generally analyzed in similar projects, necessitating more noxious or invasive weed treatments to control invasive species.

Environmental Consequences

Alternative 1 – No Action

There would be no effects to noxious or invasive weeds from management activities because none would occur. Alternative 1 would not increase forest resiliency and sustainability or reduce the risk of undesirable fire effects.

There would be no improvement in terrestrial or aquatic habitats. There would be no surveys for or treatments of noxious or invasive weeds. Survey and treatment would continue in other projects, as part of the forests' noxious weed program, and by other entities such as Arizona Department of Transportation.

Weed infestations that would have been detected and treated would go unnoticed and continue to expand unless detected by other surveys or independent observations. Treatments that would have been part of the mitigating actions would not be accomplished. As a result, treatment of weed infestations would not occur unless the locations are included in another project area or are treated by a cooperating agency. For example, treatments along highways or roadways in coordination other agencies would continue but **these treatments** would not expand outside of highway rights-of-way.

The guidance of past analyses that would allow treatment of noxious or invasive weeds on the forests, specifically the *Environmental Assessment for the A-SNFs Integrated Forest-Wide Noxious or Invasive Weed Management Program*, the *Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds, Coconino, Kaibab, and Prescott National Forests* and the *Environmental Assessment for Integrated Treatment of Noxious or Invasive Plants* for Tonto National Forest would not apply.

The design features in appendix C **of the FEIS** would not be used. These design features provide an integrated approach to noxious or invasive weed management but would not be incorporated into management activities on the forests if the no action alternative is selected.

Effects Common to Alternatives 2 and 3

The purpose of the Rim Country Project is to reestablish and restore forest structure and pattern, forest health, and vegetation composition and diversity in ponderosa pine ecosystems to conditions within the natural range of variation. Preventing, controlling, and eradicating noxious or invasive weeds is complementary to the purpose and need and would improve native vegetation composition. Management of noxious or invasive weeds is consistent with the purpose and need because management of them would contribute to the vegetation composition and diversity of the native plant community in the project area.

The action alternatives would move toward the desired conditions for native plant communities and noxious or invasive weed control. Noxious or invasive weed management would be guided by each forest's weed management NEPA. Surveys for noxious or invasive weeds would be conducted before management activities areas and needed treatments would follow the guidance of each forest's noxious or invasive weed assessment. Post implementation monitoring and treatment would occur.

To prevent the introduction and spread of noxious or invasive weeds by vehicles used in management activities, vehicles and equipment would be washed to remove soil, seeds and other debris from them before entering the area or when moving from one area to the other. Ideally, this would occur before the equipment comes onto the forest, but it can also be facilitated after entry with the approval of the contracting officer or timber sale administrator (see appendix C of the FEIS).

The direct effects of management activities on noxious or invasive weeds include ground-disturbing activities that have the potential to increase the acreage and/or density of the existing infestations within the project area. Disturbance may contribute to the spread of weeds by eliminating competition from existing vegetation and creating bare ground that is more easily invaded than undisturbed areas. Severe disturbance removes competitive vegetation, alters nutrient composition, and creates bare soil making potential sites for the invasion or spread of noxious or invasive weeds. Examples of management activities that would create localized severe disturbance include burned areas from slash piles, creation of log decks, bare soil created through road reconstruction, decommissioning, temporary road construction, in-woods processing areas and rock pits.

Tree removal indirectly affects noxious or invasive weeds by reducing tree canopy and stand density. Treatments that reduce the tree canopy and lower the stand density would affect all understory plants, including noxious or invasive weeds by allowing more sunlight, increasing available nutrients and temporarily decreasing competition. The increased availability of resources and decrease in competition can also provide favorable conditions for noxious or invasive weeds and could increase the size and density of existing populations, especially in areas where weed infestations already exist. These effects are reduced to a non-significant level by incorporating the design features (appendix C) and by incorporating survey and treatment in the project. Design features which limit the amount of soil disturbance permitted during timber sales and regulate the depth of rutting by vehicles when soil conditions are wet, minimizing soil disturbance, would help reduce the amount of disturbance during operations, reducing the amount of bare ground for noxious or invasive weeds to occupy (appendix C of the FEIS).

Burning can release nutrients, reduce plant competition, increase the amount of available sunlight and increase bare soil. Most prescribed burning would be of low severity with low soil heating, retention on most ground litter and little or no change in mineral soil (Fowler et al. 2008) (Collins et al. 2007). They concluded that low severity fires in open ponderosa pine forest had minimal effects on the abundance of noxious or invasive weeds. McGlone and Egan (2009) found similar results in studies they reviewed. Prescribed generally result in lower severity and result in lower levels of noxious or invasive weed invasion as compared to uncontrolled wildfire. In some situations, prescribed fire may result in moderate to higher severity (McGlone and Egan 2009). The effects in these areas would be more severe and would be similar to slash pile burning or wildfire. The alternatives would incorporate a series of design features and mitigations that would focus on reducing the risk of actions that would increase existing weed populations or introduce new weeds.

Alternatives 2 and 3 would incorporate a series of design features and mitigations that would reduce the risk of increasing weed coverage or extent and decrease the risk of introduction of noxious or invasive weed species not known to exist within the project area. Design features provide for collaboration between resources before the implementation of a prescribed fire. Follow-up monitoring would be conducted in areas of heavy disturbance such as large slash piles. Design features provide direction to

conduct prescribed fires under conditions that promote native plant communities, hinder weed species germination, aid with controlling existing weed infestations, and prevent the spread of existing weeds.

Direct and indirect effects of temporary road construction, road reconstruction and maintenance or road decommissioning include disturbance and increased risks of dispersal of existing weed species and populations and introduction of new species. These would be mitigated by following the design features in appendix C of the FEIS.

Management activities associated with aquatic and channel restoration would increase disturbance in certain areas. These effects would be mitigated by following the design features in appendix C of the FEIS.

A series of rock or gravel pits would be needed to provide materials for road maintenance in the project area. Appendix C of the FEIS provides a series of design features designed to minimize the risks of introduction and spread of noxious or invasive weeds within the project area.

Processing areas are likely to be in locations where invasive weeds are established during their operation. These areas would be managed under the timber sale or special use permit. To minimize the potential for invasive species spread and transport, these would be treated as part of the reclamation once operations are complete. Implementation of the design features would reduce introduction and spread of noxious and invasive weeds. Thus, while these areas would result in localized weed populations, the spread is expected to be limited. Design features (appendix C of the FEIS) provides for rehabilitation of processing areas after they are no longer used including seeding of sites with native seed which would help re-establish native plant communities and reduce the risk of noxious or invasive weed infestations. Seed mixes of native species used for post-thinning erosion would be certified as weed-free in accordance with Southwestern Region guidance for weed-free materials (USDA 2014) with a minimum of five pounds of pure live seed per acre (USDA 2014).

Alternatives 2 and 3 are expected to limit the establishment and spread of invasive species within and adjacent to the project area over the next several decades by decreasing the risk of high-severity wildfires, which are generally sources of severe disturbance. In the ponderosa and mixed conifer habitat types within the project area, nonnatives have been shown to increase with increasing fire intensity (McGlone and Egan 2009); (Fornwalt et al. 2010); (Springer et al. 2018). By decreasing fire severity, these alternatives would result in increased understory abundance and diversity which would be more resistant to invasive species over the next 10 to 20 years.

Cumulative Effects

The cumulative effects analysis area for noxious or invasive weeds includes the project area plus surrounding major arteries of transportation and utility corridors that enter the project area.

Major roads and utility corridors were included because of their roles in providing corridors for dispersal of noxious or invasive weeds. The timeframe for cumulative effects on noxious or invasive weeds is twenty years prior and twenty years into the future.

The distribution of noxious or invasive weeds in the cumulative effects area has been shaped by past management activities and natural disturbances in the project area. Activities such as firewood cutting have occurred in the past and would continue into the future. Fuel wood cutters can introduce weeds into the area through their actions. These actions occur under permit, but the forests have limited control over where these activities would occur.

Wildfires are sources of high levels of disturbance depending on fire severity. Severely disturbed areas can be more easily invaded by noxious or invasive weeds than less severely disturbed or undisturbed

areas. Numerous wildfires have occurred in the project area (see cumulative effects document). Some of these, such as the Rodeo-Chediski (2002), Juniper (2016), and Pot Fire (1996) have covered large acreages. These have resulted in large acreages of severe fire effects such as almost complete removal of the plant communities and soil erosion, leaving large areas of disturbance prone to noxious or invasive weed invasions. Some remedial actions for large fires have resulted in large acreages of non-native species that are now problematic and would be challenging to restore to native plant communities.

Past fire exclusion has contributed to the risk of noxious or invasive weed invasion by promoting very dense forests with little or no resilient understory community that would normally compete with noxious or invasive weeds. Fire exclusion also increases the risk of severe stand replacing fires and its accompanying severe disturbance.

There are numerous grazing allotments in the project boundary. The past effects of grazing and the associated activities are not completely known but may include temporary reduction of the native plant community in certain areas (especially near water sources) which would allow for plants such as the noxious or invasive weeds to enter the plant community through feed or manure.

A wide variety of recreation activities occur within the boundary of the project area including hiking, camping, hunting and recreational driving. Users can introduce noxious or invasive weeds from other areas on vehicles and personal equipment. The effects of livestock such as horses or pack animals used in recreation are similar to those in grazing and include temporary reduction of the native plant community in localized areas where animals are allowed to graze and introduction of weeds through feed or manure. Trampling and compaction can also occur if the same campsites are used repeatedly.

In the past there were few restrictions on off-road motorized travel whether for recreational or other purposes, but these actions are now regulated through implementation of the Travel Management Rule on the forests. This reduces the risk of introduction of noxious or invasive weeds and reduces vehicle damage to existing vegetation and habitat.

Major highways tend to be corridors for weed dispersal by providing a source to vector weeds into the area. Management activities associated with the highways create disturbance and spread existing weeds. Examples include past activities such as blading of road ditches where equipment passed through existing weed infestations, spreading them along the road corridor. In 2003, the Southwestern Region of the Forest Service completed the Environmental Assessment for Management of Noxious Weeds and Hazardous Vegetation on Public Roads on National Forest System Lands in Arizona. The decision, which followed in 2004, allowing treatment of noxious or invasive weeds along state and federal highway rights-of-way through all National Forests in Arizona. Some treatments have occurred along state and federal highways as a result, but the extent of these treatments is not known.

The Apache-Sitgreaves National Forests has surveyed and treated numerous infestations of noxious or invasive weeds within the project area since 2004. All of the treatments prior to the approval of the *Environmental Assessment for the A-SNFs Integrated Forest-Wide Noxious or Invasive Weed Management Program* (USDA Forest Service 2008) were mechanical treatments accomplished using hand tools. Herbicide use on the forest began in 2009 after the approval of the document.

The Coconino National Forest began weed survey and treatments in about 1995 and like the Apache-Sitgreaves, they relied on non-herbicide methods to control isolated occurrences using mechanical control and alternatives such as grazing. Using sheep to control leafy spurge was utilized before the approval of the *Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds, Coconino, Kaibab, and Prescott National Forests*; (USDA Forest Service 2005b). The EIS allowed use of herbicide as well as biological control.

There are records of surveys along roadways on the Tonto National Forest beginning in 1999. These surveys were generally by Arizona Department of Transportation. The forest began surveying for weeds in 2003. Many of the treatment prior to the approval of the *Environmental Assessment for Integrated Treatment of Noxious or Invasive Plants* (2012f) were done using hand tools.

The disturbance resulting from the management activities in this project would continue to be sources of disturbance that may contribute to the threat of noxious or invasive weed occurrences and would be additive to the activities discussed above.

Terrestrial Wildlife

This section includes key effects and conclusions for terrestrial threatened, endangered, and proposed species and critical habitat listed under the Endangered Species Act of 1973, as amended, Forest Service Southwestern Region Sensitive Species, forest management indicator species, and migratory birds. The Terrestrial Wildlife Specialist report (USDA FS 2022) is incorporated by reference. Aquatic species were analyzed separately in the Aquatics Specialist report (USDA FS 2022).

See the specialist reports for detailed information on methodology, analysis assumptions, best available science and data, habitats, populations, and effects including tables that are not repeated in this section.

Affected Environment

Vegetation Cover Types Within the Project Area

The cover types in the Rim Country project area possess key habitat features outside of the natural range of variation. These forests have less structural diversity due to more acres occurring as even-aged forest compared to historical conditions. Structure is also limited by the abundance of young and mid-aged trees and the decrease in mature and old-growth trees. These conditions do not meet land management plan direction for the ratio of age-classes interspersed across the landscape.

Habitat structure within the project area can determine the presence or absence of wildlife species. Many wildlife species select habitat provided by large and old trees, including bark gleaners (for example, pygmy nuthatches and hairy woodpeckers, which are both MIS), cavity nesters (for example, Mexican spotted owl, a threatened species), communal roosting species (for example, Allen's lappet-browed bats, a sensitive species), and larger/heavier nesting species (for example, northern goshawks, an MIS and sensitive species). Simplifying structure and declines of habitat features like aspen, Gambel oak, and the herbaceous community reduce habitat for an array for wildlife species from multiple trophic levels, including invertebrate communities and larger carnivores.

Springs, Riparian Areas, and Stream Channels

Many riparian streams in the Rim Country project area, particularly within the Rodeo-Chediski Fire area, are currently non-functioning or functioning-at-risk, with accelerated erosion and increased peak flows.

There are approximately 360 miles of fish-bearing streams in the Rim Country project area. These streams provide habitat for 12 native fish and 2 gartersnakes, including 7 federally listed species and 4 Regional Forester sensitive species (see the Aquatics Specialist report (USDA FS 2022)).

Desired conditions for riparian streams are that they are capable of filtering sediment, capturing and/or transporting bedload (aiding floodplain development, improving flood-water retention, improving or maintaining water quality), and providing ground water recharge within their natural potential. Their necessary physical and biological components provide habitat for a diverse community of plant and wildlife species including cover, forage, available water, microclimate, and nesting/breeding/transport

habitat. Stream habitats and aquatic species depend upon perennial streams or reaches and their habitat is maintained by the watershed, soil, and riparian conditions within the ecosystem.

Desired conditions for streams and aquatic habitats are to support native fish and other aquatic species, providing the quantity and quality of aquatic habitat within the natural range of variation. This includes increasing habitat complexity such as pools and large woody debris, reducing downcutting and sedimentation, improving riparian areas that provide channel stability and leaf litter, and providing stream shading to maintain water temperatures.

Wildlife Species Analyzed for this Project

Species that are evaluated here are ones known to occur within or have habitat within or adjacent to the project area. Each species from the above groups (such as, Endangered Species Act, MIS, etc.) that occurs or has the potential to occur within the project area was analyzed according to the applicable law, regulation, or policy. In some cases, surveys for these species have confirmed their presence in or near the project area. In cases where a species has not been detected, the presence of suitable habitat indicates they could be present and therefore their presence was assumed under this analysis.

The following list of federally threatened, endangered, and proposed species is adopted from the USFWS webpage (<http://www.fws.gov/southwest/es/arizona>, accessed on March 22, 2021). This list includes all federally threatened, endangered, candidate, and proposed species in the counties in the Rim Country project area. For the purposes of this analysis, only those federally-listed threatened, endangered, and candidate species and their critical habitat are analyzed. In addition, Forest Service sensitive species that are known to or have the potential to occur within the Rim Country project area are also analyzed. Species that are not present or do not have potential habitat in the project area were dismissed from further analysis as the project would have no effects on these species (table 52).

Table 52. Threatened, endangered, and forest service sensitive (TES) species evaluated

Common Name	Scientific Name	Status ¹
Northern leopard frog	<i>Lithobates pipiens</i>	S
Lowland leopard frog	<i>Lithobates yavapaiensis</i>	S
Mexican spotted owl	<i>Strix occidentalis lucida</i>	T
Western yellow-billed cuckoo	<i>Coccyzus americanus occidentalis</i>	T
Bald eagle	<i>Haliaeetus leucocephalus</i>	S
Northern goshawk	<i>Accipiter gentilis</i>	S
American peregrine falcon	<i>Falco peregrinus anatum</i>	S
Burrowing owl (western)	<i>Athene cunicularia hypugaea</i>	S
Mexican wolf	<i>Canis lupus baileyi</i>	E/10j
Navajo Mogollon vole	<i>Microtus mexicanus Navaho</i>	S
Western red bat	<i>Lasiurus blossevillii</i>	S
Spotted bat	<i>Euderma maculatum</i>	S
Allen's lappet-browed bat	<i>Idionycteris phyllotis</i>	S
Pale Townsend's big-eared bat	<i>Corynorhinus townsendii pallescens</i>	S

1. Status: E = Federally Endangered; T = Federally Threatened; E/10j population = Endangered/Experimental population (section (10)(j) of the ESA; Eagle Protection Act = Bald and Golden Eagle Protection Act; S = Forest Service Sensitive.

Table 53. Threatened, endangered, and forest service sensitive (TES) species not evaluated

Common Name	Scientific Name	Rationale for Dropping	Status ¹
Southwestern willow flycatcher	<i>Empidonax traillii extimus</i>	Neither the species nor its habitat occurs in the project area	E
Yuma clapper rail	<i>Rallus longirostris yumanensis</i>	Neither the species nor its habitat occurs in the project area	E
California condor	<i>Gymnogyps californianus</i>	Neither the species nor its habitat occurs in the project area	E
Chiricahua leopard frog	<i>Lithobates [Rana] chiricahuensis</i>	Addressed in the Aquatics Specialist Report	T
Narrow-headed gartersnake ²	<i>Thamnophis rufipunctatus</i>	Addressed in the Aquatics Specialist Report	T
Northern Mexican gartersnake ²	<i>Thamnophis eques megalops</i>	Not Addressed in the Terrestrial Wildlife Species Report	T
New Mexico meadow jumping mouse	<i>Zapus hudsonius luteus</i>	Neither the species nor its habitat occurs in the project area	E
Springerville silky pocket mouse	<i>Perognathus flavus goodpasteri</i>	Neither the species nor its habitat occurs in the project area	S
Aquatic insects	Various species	Addressed in the Aquatics Specialist Report	S/MIS
Fish	6 species	Addressed in the Aquatics Specialist Report	T and E

1. Status: E = Federally Endangered; T = Federally Threatened; E/10j population = Endangered/Experimental population (section (10)(j) of the ESA; P = Federally Proposed; S = Forest Service Sensitive; MIS= Management Indicator Species;

2. Analyzed in the Aquatics Specialist Report.

Federally Listed Threatened, Endangered, Proposed and Candidate Species and Critical Habitat

Mexican Spotted Owl (MSO)

Listing Status

The Mexican spotted owl was listed as a threatened species under the Endangered Species Act in March 1993 (USDI FWS 1993). A detailed account of the taxonomy, biology, and reproductive characteristics of the Mexican spotted owl is found in the Final Rule listing the Mexican spotted owl as a threatened species (USDI FWS 1993), in the Recovery Plan (USDI FWS 1995), and in the Revised Recovery Plan (USDI FWS 2012). Information on Mexican spotted owl in the Upper Gila Mountain Recovery Unit (UGM) is also summarized in Ganey et al. (2011). The information provided in these documents is incorporated here by reference as summarized below.

The FWS recommends recovery actions concentrate on recovery units with the highest owl populations (USDI FWS 2012). The UGM supports over half the known population of MSOs (Ganey et al. 2011). Owls appear to be more continuously distributed in the UGM, relative to other Recovery Units, and the central location of the UGM within the overall range of the Mexican spotted owl facilitates gene flow across their range (figure 82). Therefore, this Ecosystem Management Unit is important to the overall range-wide stability of MSOs.

Modeling and Habitat Evaluation

The 2012 Revised Recovery Plan (USFWS 2012) and individual land management plans describe the different levels of Mexican spotted owl habitat management, including protected, recovery, and other forest and woodland types. The stated objectives for managers are to ensure a sustained level of owl nest/roost habitat well distributed across the landscape and create replacement owl nest/roost habitat where appropriate while achieving a diversity of stand conditions across the landscape to ensure habitat for a diversity of prey species.

(Added for consistency) Protected areas include Protected Activity Centers (PACs) established around all known MSO sites located during surveys and management activities since 1989 and reserved lands which include wilderness, research natural areas, wild and scenic rivers, and congressionally recognized wilderness study areas. Prescribed fire is allowed in these areas where appropriate. PACs are 600 acres or more and typically include one or more nest sites. Core areas are 100 acres or larger, designated to encompass known nest or roost sites or the best nesting and roosting habitat available within PACs.

(Added for consistency) Recovery habitats include all mixed-conifer, ponderosa pine-oak, and riparian forests outside of protected areas. Recovery areas should be managed to ensure a sustained level of owl nest/roost habitat well distributed across the landscape. Replacement nest/roost habitat should be created where appropriate within recovery habitat while still providing a variety of stand conditions across the landscape to ensure habitat for a diversity of prey species.

Species Distribution in the Project Area

Protected Activity Centers

A total of 214 protected activity centers (120,522 acres) occur in the Rim Country project area, with 63 on the Apache-Sitgreaves National Forests, 98 on the Coconino National Forest, and 53 on the Tonto National Forest. This includes seven new protected activity centers added to the project area in 2021 that were added after the forest vegetation simulator and fire modeling was completed. See the Terrestrial Species Wildlife Specialist Report for acreages and what is proposed for treatment in these areas. An additional 39,748 acres either fall outside of the Rim Country boundary area (11,269 acres) or occur in other project areas (28,479 acres). These acres will be treated as those projects are planned and consulted with USFWS, except for the protected activity centers that are in the Clint's Well, Upper Beaver Creek,

and Rim Lakes project areas. These are included in this analysis for the Mexican spotted owl to accommodate for recent protected activity center boundary changes conducted with USFWS in these project areas and to allow for prescribed fire within nest cores. Twenty-nine of these protected activity centers would have some other type of restoration (riparian, wet meadow, grassland, aspen, etc., see Actions common to alternatives 2 and 3 below).

In the Rim Country project area up to 93,346 acres in protected activity centers are proposed for other thinning and/or burning, or other restoration activities in alternatives 2 and 3 (see Effects Analysis sections below). Working closely with the USFWS and wildlife biologists from all three national forests, we reviewed each protected activity center for treatment needs. protected activity centers were assessed in terms of dominant forest type (ponderosa pine-oak, mixed conifer, or canyons), habitat structure, available demographic data (based on ongoing occupancy surveys or past research), topographic attributes (such as aspect and slope), human access, designated wilderness boundaries, recent and ongoing projects affecting protected activity center habitat, fire history, status of current habitat, and whether mechanical treatments could move the habitat toward the desired conditions described in the Recovery Plan. It was agreed no mechanical treatments would occur in core areas.

Once the status of the protected activity center was determined, potential mechanical treatments were considered in terms of whether they could:

1. Decrease the amount of time required for growing/increasing tree height and diameter;
2. Decrease overall tree density while maintaining the density of large trees, and
3. Increase canopy base height to improve flight zone (improve owl foraging ability) and also reduce the threat of surface fires becoming crown fires.

It was determined that 11 of the 214 protected activity centers assessed did not need mechanical treatments, and that mechanical treatments were possible in 11,332 acres of protected activity centers. hand thinning only is proposed on 1,190 acres in an additional five protected activity centers. These protected activity centers would receive prescribed burning treatments in their entirety totaling an additional 77,231 acres. Under both alternatives 2 and 3, 148 miles of general stream restoration and 23 miles of heavy mechanical stream restoration treatments are proposed in protected activity centers. In Core areas, general stream restoration treatments are proposed on 23.3 miles and heavy mechanical stream restoration treatments are proposed on 4.9 miles. Alternatives 2 and 3 propose 1,741 acres of riparian restoration treatments and 6 acres of wet meadow riparian habitat treatments proposed in protected activity centers. Three acres of grassland restoration (Lake Mountain and Schell Springs) and 46 acres in eight protected activity centers of wet meadow restoration are proposed in protected activity centers. Protected activity centers were not considered for treatment if they were treated in previous projects, or if their habitat was not suitable for Rim Country treatments (some occur in designated wilderness or canyons, were previously burned, have conditions inside and outside the protected activity center that do not need active management, or there is not enough information to identify a need for treatment). Prescribed fire only was recommended for 16,541 acres in 38 protected activity centers, including using prescribed fire in core areas.

Recovery Habitat

Following Recovery Plan direction, individual land management plans direct managers to conduct a district-wide or larger landscape analysis to ascertain whether minimum recommendations for nest/roost habitat exist across the forest. One of the strengths of landscape-scale planning is the ability to compare habitat across ecological scales as encouraged in the Recovery Plan.

A new recovery layer was created within the Rim Country project area, including designation of recovery nest/roost and foraging habitat as described in the Recovery Plan. This landscape-scale approach better

meets the goal of providing continuous replacement nesting and roosting habitat over space and time, as described in the Recovery Plan.

Pine-oak habitat on the Tonto National Forest contains mostly ponderosa pine-Gambel oak to the east and ponderosa pine-evergreen oak to the west. Protected activity centers and recovery habitats on the Tonto National Forest could not all be characterized as ponderosa pine-oak (P-O) or mixed conifer (MC) and so required queries using additional criteria. A geophysical model (GM) was used to identify recovery habitats based on slope and aspect (modeled recovery habitat). We also assumed that most canyons and drainages would contain some ponderosa pine.

The results of the queries were reviewed in meetings with biologists with on-the-ground familiarity of the Apache-Sitgreaves, Coconino and Tonto National Forests. This review was to ensure that stands also provided the best functional habitat.

Proximity to protected activity center habitat was also an evaluation criterion. We sought to either augment protected activity center habitat or designate recovery habitat in previously undesignated ponderosa pine-oak stands. Fire potential was also considered in developing the spatial configuration of Mexican spotted owl habitat on the landscape. Predominant winds are from the southwest, so we rarely identified additional owl habitat southwest of existing protected activity centers unless stands were on northerly aspects. Because of the fire potential, areas southwest of protected activity centers were reevaluated for treatments that would reduce the risk of high-severity fires entering protected activity centers. A final emphasis was placed on removing stands misclassified as recovery habitat.

Habitat criteria for nest/roost habitat was met for 36,691 acres and 182,965 acres was designated as other recovery habitat as defined in the Recovery Plan (table 54). All the mixed conifer in the project area is recovery habitat.

Table 54. Acres of Mexican spotted owl (MSO) habitat

	Coconino	Apache-Sitgreaves	Tonto	Grand Total
MSO Protected Activity Centers (PAC)	49,991 (98 PACs)	39,716 (63 PACs)	30,816 (53 PACs)	120,522 (214 PACs)
Mixed Conifer Recovery Habitat Total	24,632	18,622	4,069	47,322
Foraging/Non-Breeding	18,490	12,229	2,940	33,658
Replacement Nest/Roost	6,142	6,393	1,129	13,664
Percent Replacement Nest/Roost	25%	34%	28%	29%
Pine-Oak Recovery Habitat Total	71,661	32,255	34,408	138,324
Foraging/Non-Breeding	61,016	28,250	29,419	118,685
Replacement Nest/Roost	10,644	4,005	4,989	19,639
Percent Replacement Nest/Roost	15%	12%	14%	14%
Geophysical Model Recovery Habitat Total	N/A	N/A	34,011	34,011
Foraging/Non-Breeding	N/A	N/A	30,622	30,622
Replacement Nest/Roost	N/A	N/A	3,389	3,389
Percent Replacement Nest/Roost	N/A	N/A	10%	10%
Total Replacement Nest/Roost	16,786	10,398	9,506	36,691
Total Foraging Non-Breeding	79,506	40,478	62,981	182,965
Total MSO Recovery Habitat	96,293	50,876	72,487	219,657
Total MSO Habitat	146,284	90,592	103,303	340,179

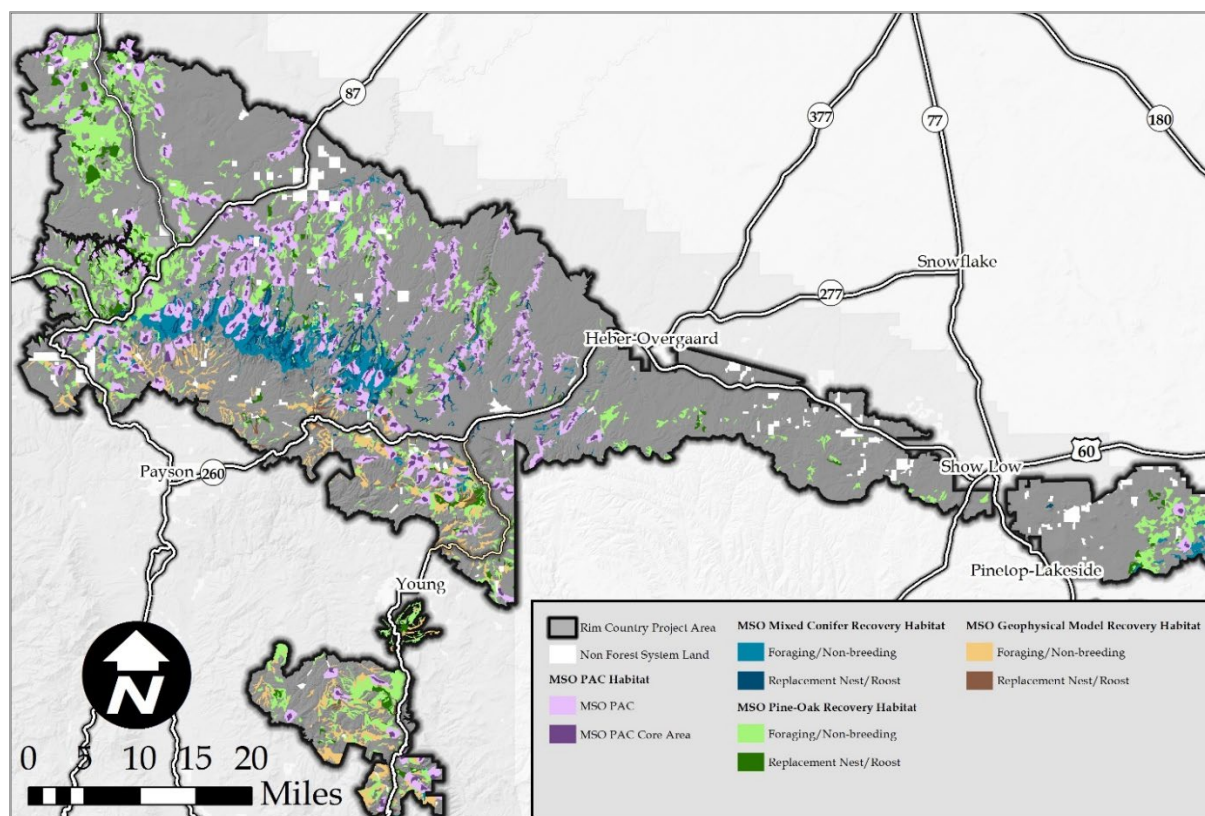


Figure 81. Mexican spotted owl habitat

Existing Condition – Modelled Fire Hazard Index, Crown Fire, and Surface Fuel Loading in

Fire Hazard Index

Changes in potential fire behavior (fire hazard index) in Mexican spotted owl habitat types was modeled by the fire ecologist (see fire ecology and air quality specialist report) under existing conditions in 207 protected activity centers on 116,385 acres (fire modeling occurred before the new protected activity centers were added to the project area). Approximately 70,328 acres (62 percent) of the protected activity centers in the project area show a Moderate, High, or Extreme need for treatment categories of fire hazard index. Of these acres modeled 51,002 acres (45 percent) have a High or Extreme need for treatment and will experience higher severity wildfire than would occur in a natural fire regime if no action is taken.

In Nest/Roost Recovery Habitat the fire hazard index modeled 38,092 acres. Approximately 22,628 acres (60 percent) of the Nest/Roost Recovery habitat in the project area show a Moderate, High, or Extreme need for treatment categories of fire hazard index. Of these acres modeled 15,869 acres (42 percent) have a High or Extreme need for treatment and would experience higher severity wildfire than would occur in a natural fire regime if no action is taken.

In Foraging/Non-breeding Recovery Habitat the fire hazard index modeled 183,706 acres. Approximately 84,363 acres (46 percent) of the Foraging/Non/breeding Recovery Habitat in the project area show a Moderate, High, or Extreme need for treatment categories of fire hazard index. Of these acres modeled 51,210 acres (28 percent) have a High or Extreme need for treatment and would experience higher severity wildfire than would occur in a natural fire regime if no action is taken.

The potential for wildfire activity that would result in more severe effects on ecosystem components than that which should occur in a natural fire regime is illustrated by this analysis. The fire hazard index would be greatly reduced in the action alternatives (see the Mexican spotted owl Environmental Consequences section).

Crown Fire

Risk of crown fires in Mexican spotted owl habitat types were also modeled under existing conditions in protected activity centers by the fire ecologist. Two hundred and seven (207) protected activity centers were modeled, totaling 116,385 acres (fire modeling occurred before the new protected activity centers were added to the project area). Of these 58,765 acres (51 percent) could experience active or conditional crown fire. Active crown fire in protected activity centers in the existing condition total 44,833 acres (39 percent) of this habitat type in the project area that would experience high-severity crown fire if no action were taken.

In Nest/Roost Recovery Habitat, crown fire potential modeled 38,093 acres, with 18,275 acres (48 percent) that have the potential to experience active or conditional crown fire. Active crown fire in Nest/Roost Recovery Habitat in the existing condition total 5,658 acres (15 percent) of this habitat type modeled in the project area that would experience high severity crown fire if no action were taken.

In Foraging/Non-breeding Habitat, crown fire potential modeled 183,706 acres, with 63,737 acres (34 percent) that could experience active or conditional crown fire. Active crown fire in Foraging/Non-breeding Recovery Habitat in the existing condition total 50,162 acres (27 percent) of this habitat type modeled in the project area that would experience high-severity crown fire if no action is taken.

As with the fire hazard index discussion above, the potential for wildfire activity that would result in more severe effects on ecosystem components than that which should occur in a natural fire regime is illustrated by this analysis. The risk of crown fire would be greatly reduced in the action alternatives (see the Mexican spotted owl Environmental Consequences section).

Surface Fuel Loading

Surface fuel loading in Mexican spotted owl Protected Habitat in the existing condition is 26 tons per acre in mixed conifer and 19 tons per acre in ponderosa pine oak. Land management plans call for fuel loading in tons per acre of 5 to 15 tons in mixed conifer and 3 to 10 trees per acre in ponderosa pine oak cover types. The forest vegetation simulator modeling shows that after 20 years these fuel loads are well above the desired conditions in this habitat type.

Surface fuel loading in Mexican spotted owl Nest/Roost Recovery Habitat would move from 28 tons per acre in mixed conifer, 18 in ponderosa pine oak, and 23 Geophysical Model to 35 tons per acre in mixed conifer, 25 tons per acre in ponderosa pine oak and 28 Geophysical Model after 20. The forest vegetation simulator modeling shows that after 20 years these fuel loads exceed the desired conditions in this habitat type.

Critical Habitat and Primary Constituent Elements in the Project Area

Mexican spotted owl critical habitat was designated by the USFWS in 2004 (USDI FWS 2004). Critical habitat is defined as protected and recovery habitats within designated areas which contain the primary constituent elements (PCEs) necessary for conservation of the species (USDI FWS 2004). A detailed list of PCEs can be found in the Evaluation Criteria section below.

Two critical habitat units occur partially or completely within the Rim Country project area (figure 82). They encompass 686,287 acres of Forest Service land, including mixed-conifer forest, but do not include State, private, Naval Observatory, or certain wildland-urban interface areas (11,650 acres). Approximately

410,000 acres do not have PCEs for Mexican spotted owl critical habitat so are not analyzed for effects. A total of 266,275 acres of Mexican spotted owl protected and recovery habitat occurs within the critical habitat units in the Rim Country project area. Alternatives 2 and 3 treat different amounts of this habitat (see analysis below). Fire modeling in Mexican spotted owl critical habitat used the complete acres, regardless of ownership/management, on 686,287 acres.

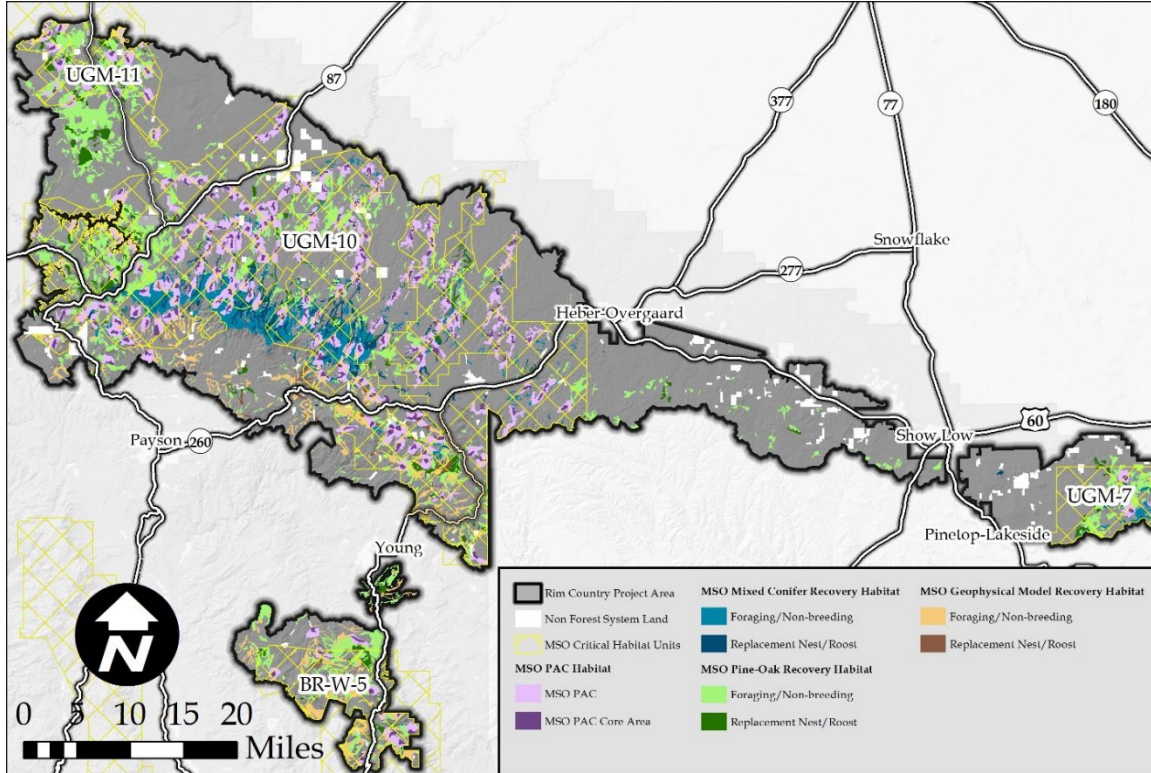


Figure 82. Mexican spotted owl critical habitat units

Table 55. Mexican spotted owl (MSO) protected and recovery habitat within critical habitat within the Rim Country project area

	BR-W-5	UGM-10	UGM-11	UGM-7	Grand Total
MSO PAC	4,853	96,160	9,007	1,578	111,599
MSO Recovery Habitat	20,340	109,381	14,711	10,243	154,676
MSO Recovery Replacement Nest/Roost	2,150	20,640	2,464	951	26,205
MSO Recovery Foraging/Non-Breeding	18,191	88,741	12,247	9,293	128,470
Non-MSO Habitat	29,781	333,132	21,658	23,788	408,359
Grand Total	54,974	538,673	45,376	35,610	674,634

PAC – protected activity center

In Rim Country, all of UGM-10, small portions of UGM-7, and UGM-11 are in the project boundary. In Basin and Range West, all of BRW-5 is in the project area.

In the Upper Gila Mountains Ecological Management Unit (UGM EMU) Federal lands encompass 67 percent of the UGM EMU. The revised Mexican spotted owl recovery plan states that of the 688 known owl sites in this EMU, 684 sites are designated on Forest Service-administered land. One hundred

ninety-three PACS (93 percent of the protected activity centers in the project area) occur within the project area in this EMU.

In the Basin and Range West EMU, Federal lands encompass 40 percent of the BRW EMU. Of the 174 owl sites in this EMU, most occur on Forest Service administered lands (89 percent) with the majority of these sites on the Coronado National Forest within wilderness which is outside of the Rim Country planning area. Fourteen PACS (7 percent of the protected activity centers in the project area) occur within the project area in this EMU.

For Protected and Recovery habitats for the Mexican spotted owl, the following evaluation criteria were used to compare environmental consequences for alternatives in critical habitat:

- Impacts to PCEs related to forest structure
 1. Changes in basal area by tree size-classes to show uneven aged management by alternative within Mexican spotted owl Habitats.
 2. Percent Canopy cover in Mexican spotted owl habitats.
- Impacts to PCEs related to dead standing trees (snags)
 1. Change in numbers per acre of snags, with a diameter of 12 to 18 inches (Average of Snags 12 to 18 inches diameter at breast height) and
 2. greater than 18 inches by alternative in Mexican spotted owl Habitats (Average of Snags greater than 18 inches diameter at breast height).
- Impacts to PCEs related to maintenance of adequate prey species (Course Woody Debris and Understory (to maintain fruits, seeds, and regeneration to provide needs of Mexican spotted owl prey species in Mexican spotted owl Habitats).
 1. Coarse woody debris surface fuel 3 inches or greater in tons per acre in Mexican spotted owl habitats.
 2. Changes in tons per acre shrub biomass and,
 3. Changes in tons per acre herbaceous biomass.
- To analyze the effects of fire by alternative in Mexican spotted owl habitats the following variables were modeled and reviewed:
 1. Changes in tons per acre by alternative of total surface fuel.
 2. Changes in potential fire behavior (Fire Hazard Index) by alternative in Mexican spotted owl habitats.
 3. Changes in risk of crown fire by alternative and Mexican spotted owl habitats

Critical habitat includes a subset of both protected and recovery habitat, as defined in the Recovery Plan. Designated Critical habitat in the project area consists of 111,599 acres of protected habitat (protected activity centers) and 154,676 acres of Recovery habitat.

Recommendations from the plan are to treat up to 20 percent of any non-core area acres in any EMU mechanically over 10 years. Collectively, in subunits (UGM 7, 10, 11, and collectively in BR-W-5)

mechanical thinning will not exceed 20 percent of non-core areas in any one EMU over 10 years. Primary Constituent Elements (PCEs) of Mexican spotted owl habitat and prey base were incorporated into the analyses, allowing for an effects determination to the Mexican spotted owl critical habitat in the Rim Country project area.

Western Yellow-billed Cuckoo

Listing Status

The western distinct population segment of the western yellow-billed cuckoo (hereafter yellow-billed cuckoo) was listed as a threatened species under the Endangered Species Act on October 3, 2014 (USFWS 2013, 2014b; 78 FR 61622, 79 FR 59992). Within the population segment (see figure 1 at 79 FR 59994, in the final listing rule (79 FR 59992; 2014b)), the habitat areas used by the species for nesting are located from southern British Columbia, Canada, to southern Sinaloa, Mexico, and may occur from sea level to 7,000 feet (2,154 meters) in elevation (or slightly higher in western Colorado, Utah, and Wyoming). Critical habitat for the yellow-billed cuckoo population segment was proposed on August 15, 2014 encompassing 546,335 acres across the western United States (USFWS 2014a; 79 FR 48548). The discussions of the status of this species in these documents are incorporated herein by reference. A revised proposed rule was completed in April of 2021 (USDI FWS 2021b).

Range and Life History

In Arizona, the species was a common resident in the (chiefly lower) Sonoran zones of southern, central, and western Arizona (Phillips et al. 1964). The yellow-billed cuckoo now nests primarily in the central and southern parts of the state, as well as at revegetation sites along the lower Colorado River (MacFarland and Horst 2015; USFWS 2013, 2014c, 2014d, McNeil et al. 2013). In the Southwest, the yellow-billed cuckoo usually occurs in association with large blocks of mature riparian cottonwood-willow woodlands and dense mesquite associations (USDA FS 2021b). Habitat features of the yellow-billed cuckoo indicate a preference for areas with a closed canopy and a sub-canopy layer (USDA FS 2021b). Dense understory foliage appears to be an important factor in nest site selection, while cottonwood trees are an important foraging habitat in areas where the species has been studied in California (USDA FS 2021b). Nesting west of the Continental Divide occurs almost exclusively close to water (USFWS 2013).

Species Distribution in the Project Area

The western distinct population of the yellow-billed cuckoo is not known to occur in the project area. No critical habitat areas have been identified within the Rim Country project area for the yellow-billed cuckoo, though critical habitat units are seven miles east and south of the project area.

There have been no systematic surveys for the yellow-billed cuckoo on the Apache-Sitgreaves National Forests; however, there are some incidental known occurrences, all of them on the Apache National Forest side. The cottonwood-willow riparian forest cover type occurrence on the Sitgreaves National Forest side of the Apache-Sitgreaves National Forests is not likely to provide habitat extensive enough for nesting. On the Tonto National Forest, in previous years there have been detections of yellow-billed cuckoo in Rye Creek on the Payson-Tonto Basin border near Rye and Gisela creeks yellow-billed cuckoo have also been found along the Verde River and Cherry Creek (Tonto Basin portion). It is possible that yellow-billed cuckoos could be present in some of the drainages in the Rim Country footprint. In the project area it is estimated that there is approximately 14,500 acres of available habitat.

Critical Habitat and Primary Constituent Elements in the Project Area

The Rim Country Project area does not contain critical habitat for yellow-billed cuckoos.

Mexican Wolf

Listing Status

The Mexican wolf, *Canis lupus baileyi*, is an endangered subspecies of gray wolf protected by the Endangered Species Act (80 FR 2488, January 16, 2015) (ESA). On January 12, 1998, the U.S. Fish and Wildlife Service published an Endangered Species Act section 10(j) rule for the Mexican wolf that provided for the designation of specific populations of listed species in the United States as “experimental populations”. The Mexican wolf has been reintroduced on national forests in Arizona and New Mexico. These wolves have been designated as a non-essential experimental population, pursuant to section 10(j) of the Endangered Species Act as amended.

The following is an excerpt from the USFWS 2014 Final Environmental Impact Statement for the Proposed Revision to the Regulations for the Nonessential Experimental Population of the Mexican Wolf (*Canis lupus baileyi*) (USFWS 2014b):

Disturbance-causing land-use activity means any activity on Federal lands within a 1-mi (1.6-km) radius around release pens when Mexican wolves are in them, around active dens between April 1 and July 31, and around active Mexican wolf rendezvous sites between June 1 and September 30, that the Service determines could adversely affect reproductive success, natural behavior, or persistence of Mexican wolves. Such activities may include, but are not limited to—timber or wood harvesting, prescribed fire, mining or mine development, camping outside designated campgrounds, livestock husbandry activities (for example, livestock drives, roundups, branding, vaccinating, etc.), off-road vehicle use, hunting, and any other use or activity with the potential to disturb wolves. The following activities are specifically excluded from this definition:

1. Lawfully present livestock and use of water sources by livestock;
2. Livestock drives if no reasonable alternative route or timing exists;
3. Vehicle access over established roads to non-Federal land where legally permitted activities are ongoing if no reasonable alternative route exists;
4. Use of lands within the National Park or National Wildlife Refuge Systems as safety buffer zones for military activities and Department of Homeland Security border security activities;
5. Fire-fighting activities associated with wildfires; and
6. Any authorized, specific land use that was active and ongoing at the time Mexican wolves chose to locate a den or rendezvous site nearby.

Thinning and burning projects have the potential to affect wolves, especially when reproduction and denning activities are disrupted. The Forest Service would work closely with the wolf field team to identify sensitive areas and avoid temporal disruptions that could negatively affect Mexican wolves.

Range and Life History

The Mexican wolf is a top predator native to the southwestern United States and Mexico that lives in packs and requires large amounts of forested terrain with adequate ungulate (deer and elk) populations to support the pack. Predator eradication programs in the mid to late 1800’s to mid-1900’s resulted in the near extinction of the Mexican wolf. Extinction was averted with the inception of a captive breeding program founded with seven Mexican wolves.

In the United States, Mexican wolves were reintroduced to the wild in 1998 in the Mexican Wolf Experimental Population Area, an area designated for Mexican wolf reintroduction in Arizona and New Mexico. The Mexican wolf population in this population area has exhibited robust growth in recent years. In 2016, a population of at least 113 wild Mexican wolves inhabited the population area (USFWS 2017).

The end of year census for 2019 was a minimum of 163 Mexican wolves in the wild (76 in Arizona and 87 in New Mexico). This was a 24 percent increase in the population from a minimum of 131 wolves counted at the end of 2018 (USFWS 2021a).

The threats to the Mexican wolf have generally remained consistent over time, including human-caused mortality and related legal protections, extinction risk due to small population size, and loss of genetic diversity (USFWS 2017).

Species Distribution in the Project Area

Figure 83 shows areas of potential wolf habitat and includes parts of the Rim Country planning area classified as high quality. The closest pack and denning is the Cerro Trigo Pack, which mainly occupies the Springerville Ranger District and occasionally crosses into the Lakeside Ranger District near the 4FRI Rim Country project area in 2019 and 2020. Radio-collared wolves on the Black Mesa District of the Apache-Sitgreaves National Forests have recently been located within the Rim Country boundary (USDA FS 2017), before returning to the east. In 2018, another lone male passed through Rim Country from the Gila Wilderness in New Mexico to the Kaibab National Forest west of Flagstaff. Also, in 2018, un-collared wolves were confirmed in the Heber/Overgaard area. Given wolves' capacity for long-distance dispersals (Mech et al. 1995), we could reasonably predict that more individuals could occur within the Rim Country project area during the planning and implementation of the project. Coordination between the Forest Service and the Inter-Agency Field Team (IFT) would occur before phases of implementation to verify wolf occurrences in projects area.

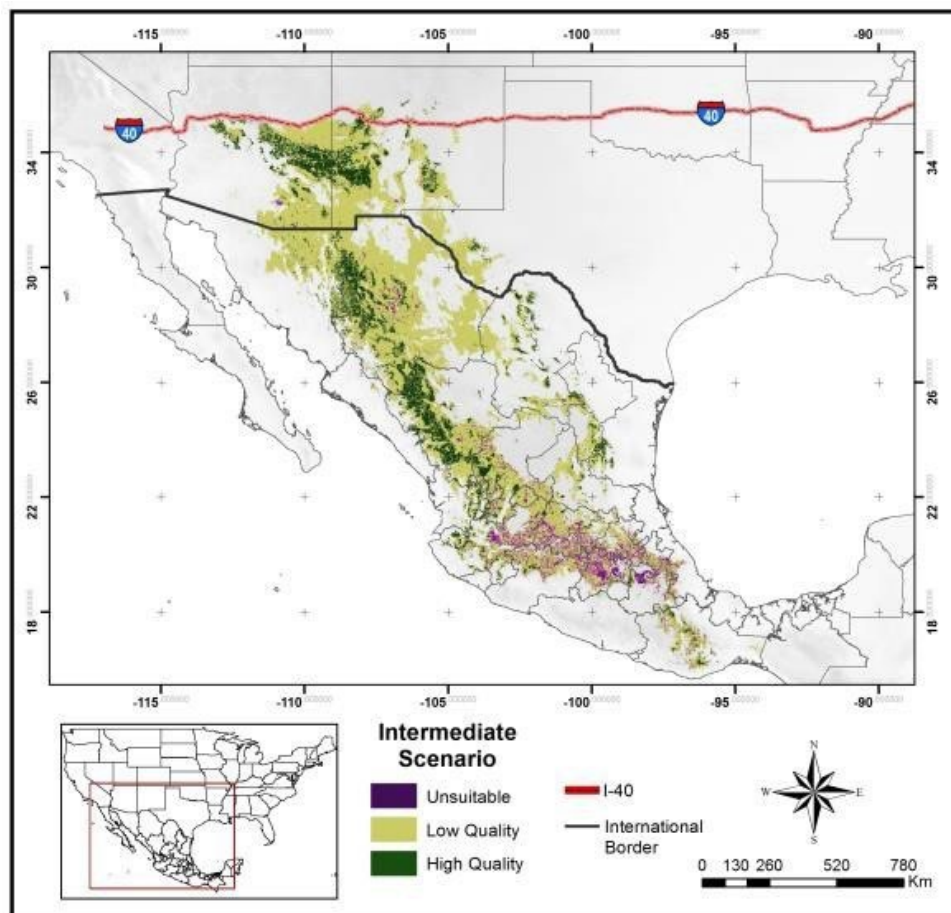


Figure 83. Focal area for Mexican wolf recovery strategy, including the MWEPA in the United States, and the Sierra Madre Occidental in Mexico

Forest Service Sensitive Species

The lowland leopard frog, northern leopard frog, American peregrine falcon, western burrowing owl, sulphur-bellied flycatcher, Navajo Mogollon vole, western red bat, Allen's lappet-browed bat, Pale Townsend's big-eared bat, and spotted bat affected environment sections were added to the FEIS from the Terrestrial Wildlife Specialist report for consistency. These additions are not new information and were present in the Terrestrial Specialist Report published with the DEIS.

Sensitive species are defined as "those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by: (a) significant current or predicted downward trends in population numbers or density, or (b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution (FSM 2670.5(19))."

The most recent Regional Forester's Sensitive Species list was transmitted to Forest Supervisor's in September 2013 and is the basis for the species used for this analysis. If survey information was not available, the assumption was made that potential habitat was occupied. The presence of species carried forward for analysis was determined by consulting forest records, results of surveys conducted on the forest, and use of the FAAWN database (Patton 2011) and NRM.

Thirteen Regional Forester Sensitive Species occur within the project area. In-depth descriptions of these species and further information can be found in the Wildlife Specialist Report. The northern goshawk and analysis for this species is included below because key issues were raised by the public regarding treatment in northern goshawk habitat.

Northern Goshawk

This analysis addresses policy requirements and responds to key issues raised by the public including Issue 2, Treatments in northern goshawk Habitat and Issue 3, Large Tree Retention. Indicators include changes in the amount and/or quality of northern goshawk nesting and post-fledging family area (PFA) habitat. Specific measures include:

1. Acres treated by habitat/vegetation type by alternative in PFAs and areas outside of PFAs.
2. Changes in tree size-classes by alternative in PFAs and areas outside of PFAs.
3. Percent canopy cover by alternative in PFAs and areas outside of PFAs.
4. Number per acre of snags logs, and tons per acre coarse woody debris in PFAs and areas outside of PFAs.
5. Changes in percent shrub and herbaceous biomass (to maintain fruits, seeds, and regeneration to provide needs of northern goshawk prey species) in PFAs and areas outside of PFAs.
6. Changes in potential fire behavior (Fire Hazard Index) by alternative in PFAs.
7. Changes in risk of crown fire by alternative in PFAs.

The FEIS utilizes and incorporates by reference the vegetation cover type and vegetation existing condition information provided in the silviculture specialist report and the respective forest wide Management Indicator Species (MIS) reports.

Land Management Plan Compliance and Analysis Framework

Land management plan direction for northern goshawks applies to northern goshawk habitat outside of Mexican spotted owl habitat. In ponderosa pine forest, one or the other set of guidance applies, and Mexican spotted owl guidance takes precedence in areas of overlap.

Fire Hazard Index and Risk of Crown Fire

Fire hazard index and risk of crown fire was modeled in PFAs under existing conditions. Of the 41,590 acres modeled 11,731 acres (28 percent) of the PFAs in the project that could potentially experience high or extreme severity wildfire. The risk of crown fire was modeled in PFAs based on the existing condition. Approximately 14,978 acres (36 percent) of PFAs in the Rim Country project area are at risk of experiencing active or conditional crown fire.

In Lands Outside of PFAs fire modeling was modeled on 832,077 acres, representing pine and mixed conifer cover types available in the project area outside of established PFAs. The fire hazard index (FHI) for Lands Outside of PFAs in the existing condition indicate that of the acres modeled 215,704 acres (26 percent) are at a High or Extreme need for treatment. The risk of crown fire was modeled in Lands Outside of PFAs based on the existing condition. Approximately 459,806 acres (56 percent) of Lands Outside of PFAs in the Rim Country project area are at risk of experiencing active or conditional crown fire.

Habitat Strata and Scales of Analysis

Post-fledging family areas are about 600 acres in size (including the nest areas, replacement nest areas, and habitat most likely to be used by fledglings during early development). Post-fledging family areas were considered occupied. The Apache-Sitgreaves National Forests Revised Land Management Plan (2015), Coconino National Forests Revised Land Management Plan (2018), Tonto National Forest Land Management Plan (1985), and have direction to include a minimum of six nest areas and replacement nest areas within each PFA. Nest areas would be about 25 to 30 acres in size (minimally 30 acres (Coconino National Forest)) and based on active nest sites followed by the most recently used historical nest sites.

Northern Goshawks Post-fledging Family Areas

There are 106 PFAs on the Apache-Sitgreaves, Coconino, and Tonto National Forests, totaling 55,608 acres in the Rim Country project area. Of these acres, 22,320 are within other project areas (figure 84). Approximately 35,549 acres of PFA habitat would be treated with mechanical thinning and/or prescribed fire in the proposed action. A PFA was only counted once if a portion of that PFA occurs on more than one forest. Figure 84 shows the distribution of northern goshawk PFAs in the Rim Country project area. The Rim Country Condition-based Management Approach for Mechanical Treatments identifies PFAs as areas where special prescriptions would promote habitat variables needed by this species.

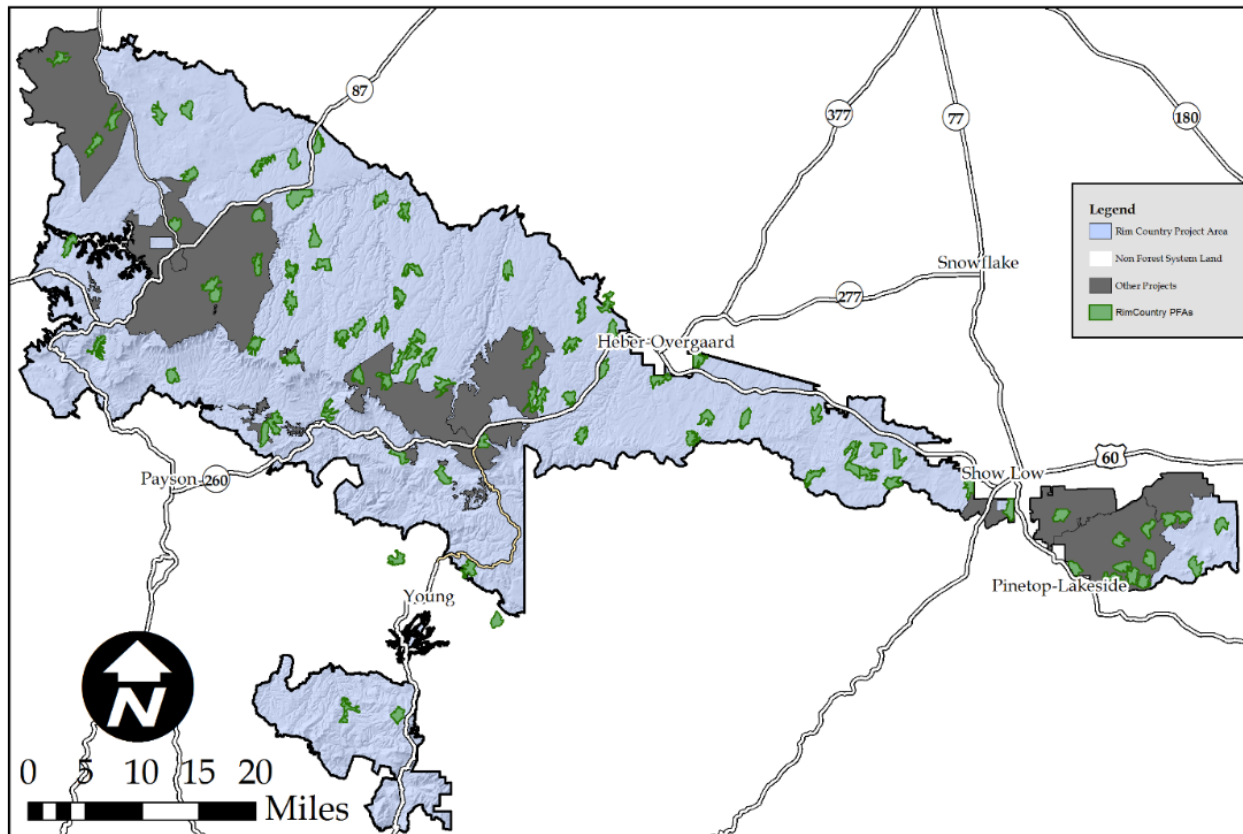


Figure 84. Northern goshawk PFAs

Bald Eagle

The USFWS removed the bald eagle in the lower 48 states of the United States from the Federal List of Endangered and Threatened Wildlife as of August 8, 2007 (USDI FWS 2007d). Eagles are currently protected under the Golden and Bald Eagle Protection Act and are a Forest Service sensitive species.

The USFWS recommends using the Conservation Assessment and Strategy for Bald Eagles in Arizona (Driscoll et al. 2006) in conjunction with the Bald Eagle National Management Guidelines (USDI FWS 2007) to protect bald eagles in Arizona. These guidelines were incorporated into the Rim Country as design features or mitigation.

Bald eagles in central Arizona prefer to nest on cliff ledges or pinnacles or in tall trees (USDI FWS 1982). Bald eagles are habitat generalists and opportunistic feeders, typically taking the easiest and most abundant prey, regardless of whether it is dead or alive (Joshi 2009). They mainly forage on waterfowl and fish found along major streams; however, they do hunt in the uplands and forage on various mammal species, especially in the winter.

Nesting

Bald eagle numbers in Arizona have increased since 2008, with the number of breeding areas recorded increasing from 56 in 2008 to 92 in 2021. Active breeding areas increased from 44 in 2008 to 62 in 2021. The number of young fledged has increased from 53 in 2008 to 55 in 2020. Nesting success is partially attributed to the AZGFD Bald Eagle Nest Watch Program and to Forest Service closures around nest sites (Show Low Lake and Chevelon Canyon on the Apache-Sitgreaves National Forests).

There are seven nesting pairs of bald eagles within or near the project area (table 56).

Table 56. Bald eagle nests in the project area

Breeding Area	Location: Forest/Ranger District	Status /Recent Nesting History
Fool Hollow Lake	Apache-Sitgreaves, Lakeside	Nest failed in 2017. Successful nest in 2018, 1 fledged. Nest failed in 2019. Nest in 2021, 1 young in nest, April 7, 2021.
Chevelon Canyon Lake	Apache-Sitgreaves, Black Mesa	Successful nest in 2016, 2 fledged. Nest fell in 2017. Nest failed in 2018. Nest failed in 2019.
76	Tonto, Tonto Basin RD	Active. Successful nest in 2016, 2 fledged. Nest successful in 2017, 2 fledged. Successful nest in 2018, 1 fledged. Nest successful in 2019, 1 fledged. Nest in 2021, 1 young in nest, April 7, 2021.
Silver Creek	Private, Adjacent to Tonto National Forest, Payson	Active. 2 fledged in 2015. Nest successful in 2017, 1 fledged. Nest successful in 2018, 2 fledged. Nest successful in 2019, 1 fledged. Nest in 2021, 1 egg in nest.
Show Low Lake	Apache-Sitgreaves, Lakeside	Nest successful in 2017, 2 fledged. Nest successful in 2018, 1 fledged. Active. Nest failed in 2019. Nest in 2021, 1 young in nest, April 7, 2021
Woods Canyon	Apache-Sitgreaves, Black Mesa	Active. 1 fledged in 2016 and 1 fostered from Show Low Lake. Fledged 1 in 2018. Nest successful in 2019, fledged 1. Nest in 2021, 1 egg in nest.
O.W. / Canyon Creek	Tonto, Pleasant Valley	First nest attempt in 2018, nest failed. Nest failed in 2019. Occupied in 2021.

Wintering

Bald eagles occurring on the Apache-Sitgreaves and Coconino National Forests are primarily winter visitors. Bald eagles overwintering in northern Arizona are primarily migratory individuals that breed in the northern U.S. and Canada (Grubb et al. 1982). They are often seen scavenging on carrion, including large and small mammals, or around some of the waters supporting fish and waterfowl. The AZGFD provided important wintering bald eagle habitat areas to consider for the Rim Country analysis. These included the Lakeside Ranger District of the Apache-Sitgreaves' various lakes: Mogollon Plateau: Lower Lake Mary Road; Rattlesnake Canyon: Lake Mountain, Verde River Valley, Wingfield Mesa, Mogollon Plateau, Jack's Canyon; Mogollon Plateau: Slim Jim Ridge; Mogollon Rim: West Chevelon Canyon; Chevelon Canyon Lake; Mogollon Rim: Cottonwood Wash; Sierra Ancha: Dupont Canyon; Willow Springs Lake; and the Buckhead Mesa Landfill.

Small to moderate-sized groups of bald eagles (typically two to 48) roost in clumps of large trees in protected locations such as drainages and hillsides (Grubb and Kennedy 1982, Dargan 1991, Grubb 2003). Bald eagle winter night roosts typically consist of clumps of large (average diameter at breast height of 30 inches) trees on steep slopes that tend to occur on east-facing aspects (Joshi 2009). Group sites are typically in stands of ponderosa pine trees of less than an acre up to 43 acres, most often on north or northeast-facing slopes close to daytime foraging areas (Dargan 1991). Day roosts are often trees or snags near water or roadways. Bald eagles are highly mobile in the winter and can fly great distances in search of aquatic or terrestrial prey and suitable nighttime roosting habitat.

Golden Eagle

Golden eagle nesting within the Rim Country project area has been recorded on the eastern boundary on the Verde River, outside of the project area on Deadman's Mesa and approximately 2 miles north of the project area on the Tonto National Forest, Pleasant Valley Ranger District. South of the project area in the Sierra Ancha, seven golden eagle historic and active nest sites are within 1 to 3 miles of the project area. Approximately 3 miles north of Rim Country on the Apache-Sitgreaves National Forest, Black Mesa District there is an active nest site (2015) north of Heber, Arizona in Black Canyon and another northeast of Chevelon Crossing.

American Peregrine Falcon

There are 25 confirmed nesting pairs of peregrine falcons within the project area. Known nest locations, tall cliffs, open waters, and meadows provide potential habitat within the project area. Land management plan guidelines prohibit activities that can potentially disturb peregrine falcons in the vicinity of occupied nesting habitat between March 1 and August 15.

Western Burrowing Owl

Burrowing owls are found in flat, open, low-stature grasslands, sparsely vegetated desert shrub, and edges of human disturbed land. These owls take over burrows of prairie dogs and ground squirrels, and dens of coyote, fox and badger. They are also known to use artificial burrows. These owls also need perches, such as mounds and fence posts. They primarily eat insects and small mammals, but are known to take other small-sized species. Breeding Bird Atlas surveys confirmed nesting from approximately 100 feet elevation near Gladsden to 6,600 feet elevation in a prairie dog colony near Flagstaff however burrowing owls have not been confirmed within the project area. Similar to prairie dogs, burrowing owls are associated with the Great Basin/Colorado Plateau grassland and steppe, montane subalpine, and semi-desert grasslands. There are 31,293 acres of grassland habitat within the project area that provide potential habitat for prairie dogs and consequently, burrowing owls. There is no specific land management plan direction for burrowing owls or prairie dogs; however, guidelines for mountain grassland are to evaluate the need to maintain and improve meadows by eliminating competing conifers, stabilizing gullies to restore waters tables, and reseeding with desirable species.

Sulphur-bellied Flycatcher

These flycatchers primarily nest (in snags) in the sky islands of southeastern Arizona, but have been found as far west as the Baboquivari Mountains and locally north to the Sierra Ancha. E-Bird shows one record from Pine Creek, which is adjacent to the project area. There is a 1997 breeding record from as far north as Oak Creek Canyon near West Fork. They typically nest from 4,500 to 6,000 feet in elevation (Corman and Wise-Gervais 2005).

Navajo Mogollon Vole

Hoffmeister (1986) delineated the range for this vole from the Navajo Mountain southward to the western part of the Mogollon Plateau, extending from near Mormon Lake westward toward the town of Williams and up to the Tusayan Ranger District. They live in a variety of habitats from 3,800 to 9,700 feet in elevation, including ponderosa pine forest and montane subalpine grasslands. Whether or not Navajo Mogollon voles are found in forests, shrublands, or grasslands, they are associated with grassy vegetation (Hoffmeister 1971). They select drier habitats than long-tailed voles, which typically occupy moister habitats (Hoffmeister 1971). They occur within open forests and in larger grassland areas such as Garland and Government Prairies on the Williams Ranger District (Ganey and Chambers 2011). They typically nest underground with runways leading from the burrow entrance out to their foraging areas. They preferentially forage on cool season or C-3 photosynthesis grasses (Chambers and Doucett 2008, Ganey and Chambers 2011). Other grasses can also provide food and voles rely on other herbaceous species for cover. In a study evaluating understory vegetative cover, clumpy tree distribution, decreased pine basal area and snags greater than 16 inches in diameter were identified as strong drivers for Mogollon vole occupancy (Kalies et al. 2010). There are over 689,503 acres of ponderosa pine and 31,293 acres of grassland within the project area.

Western Red Bat

The western red bat is thought to be a summer resident of northern Arizona. It primarily occurs along riparian corridors among oaks, sycamores, and cottonwoods at low elevations, but may occur up to 7,200 feet where it roosts in dense clumps of foliage. In the Grand Canyon, Hoffmeister (1971) reports

they were only known from the bottom of the canyon near Phantom Ranch and along Bright Angel Creek. Summer habitat associations include coniferous forest (Western Bat Working Group 2005a). Although generally solitary, western red bats forage in close association with one another in summer and may migrate in groups. They typically feed along forest edges or in small openings. Large lepidopterans are considered main prey items, but homopterans, coleopterans, hymenopterans, and dipterans have also been reported in their diets (Western Bat Working Group 2005a). On rare occasion, red bats have been documented near Kachina Village, upper West Clear Creek Wilderness, and Page Springs Fish Hatchery. The latter two locations are outside of the project area. One bat was radio-tracked near Kachina Village within the project area and roosted in a clump of Gambel oak in dry ponderosa pine forest (Chambers personal comm. 2010). They roost primarily in the foliage of trees or shrubs but occasionally use caves. Given they are an uncommon summer resident on the Coconino National Forest, they could conceivably be a rare visitor on the Apache-Sitgreaves and Tonto National Forest as well. Recent (2018) NaBAT data has confirmed red bat recordings on the Tonto inside the project area.

Land management plan guidelines state rare and unique features (such as, talus slopes, cliffs, canyon slopes, caves, fens, bogs, sinkholes) should be protected from damage or loss in order to retain their distinctive ecological functions and maintain viability of associated species.

Both caves and abandoned mines are available for roosting bats, reducing the potential for displacement, abandonment of young, and possible mortality. Caves and abandoned mines that are used by bats should be managed to prevent disturbance to species and spread of disease (such as, white-nose syndrome). Potential foraging habitat within the project area includes 689,503 acres of ponderosa pine and 31,923 acres of grassland. Roosting habitat may occur along the 777 miles of riparian habitat.

Allen's Lappet-browed Bat

Allen's lappet-browed bat is known to occur in a wide variety of habitats in the southwestern U.S. and Mexico. They are known to occur within the Rim Country area (Patton 2014). In Arizona, Allen's lappet-browed bats have been found in ponderosa pine, pinyon-juniper, Mexican woodland, white-fir forests, and Mohave Desert scrub. They are often associated with water. Hoffmeister (1986) documents Allen's lappet-browed bats occupying mine shafts or rocky areas and cliffs for roosts. A study conducted within the project area documented lappet-browed bats using snags for maternity roosts. It appears that males segregate during the maternity season and use cliff habitat, while females typically select taller snags with sloughing bark closer to forest roads for raising their pups (Solvesky and Chambers 2009). While snags are not a long-lasting form of forest structure, snags with sloughing bark are even more ephemeral. Female roosts were all within ponderosa pine forest. Allen's lappet-browed bats feed on flying insects, often over open waterbodies (including stock tanks) and wetlands where flying insects are abundant. However, foraging habitat can be diverse and includes ponderosa pine forest, forest openings, wet soils, and diverse herbaceous ground cover. They occur across the ponderosa pine belt on the, Apache-Sitgreaves, Coconino, and Tonto National Forests and have been documented in the project area. Potential habitat within the project area is 689,503 acres of ponderosa pine and 114,753 acres of pinyon-juniper.

Pale Townsend's Big-eared Bat

Pale Townsend's big-eared bat occurs across a broad range in western North America. A 2007 bat roost inventory and monitoring project documented Townsend's big-eared bats on both the Apache-Sitgreaves and Coconino National Forests (Solvesky and Chambers 2007). The Tonto National Forest has records from the 1990s but they are outside the project area, and 2018 recordings from NaBAT near the project area. Pale Townsend's big-eared bat are known to occur near and likely within the project area. They use a wide range of habitats, including ponderosa pine forest. Pale Townsend's big-eared bat typically roost in rock structures (such as, caves, mines, and lava tubes), and abandoned buildings, but will also use hollow trees. Pale Townsend's big-eared bats are apparently secure, although loss of cave and mine habitat may

be causing a decline in numbers and there is concern over loss of genetic variability within populations (Western Bat Working Group 2005b). Pale Townsend's big-eared bat are sensitive to disturbance and roost sites have been abandoned because of human recreation. They feed on flying insects and often forage over waterbodies and wetlands where flying insects are abundant. The species is a moth specialist with over 90 percent of their diet composed of lepidopterans. They travel long distances while foraging and use edge habitat adjacent to or within forest habitat (Western Bat Working Group 2005b). Habitat features potentially benefiting prey species include pools, stock tanks, wet ground, herbaceous ground cover, and edge habitat. Potential habitat includes 689,503 acres of ponderosa pine and 31,293 acres of grassland within the project area.

Spotted Bat

Historic records suggest that the spotted bats are widely distributed, rare across their range, but can be locally abundant. The historic range of the spotted bat includes Mexico and the Southwest and north up to Canada. In Arizona, spotted bats commonly roost singly in crevices in rocky cliffs and they have also been found in caves (Chambers, pers. comm. 2009). Cliff habitat and surface water are characteristic of localities where they occur. Spotted bats are lepidopteran specialists and will forage in upland meadows. Meadows, openings, and open forests with diverse herbaceous ground cover provide habitat for prey species. There are 689,503 acres of ponderosa pine and 31,293 acres of grassland within the project area.

Forest Service Management Indicator Species

The Tonto National Forest is the only Forest with Management Indicator Species (MIS). The Apache-Sitgreaves and the Coconino National Forests revised their land management plans and established focal species that are analyzed when plan revisions occur and not on specific projects. The proposed project would affect ponderosa pine, mixed conifer, aspen, pinyon-juniper, grassland/savannah, ephemeral streams, and spring habitats. MIS or their respective habitat components that do not occur within the proposed Rim Country project area would not be analyzed. The presence of species carried forward for analysis was determined by surveys conducted on the forests and the FAAWN (Forest Attributes and Wildlife Needs) database (Patton 2011).

Sixteen MIS whose distribution across the Tonto National Forest encompass part of the project area are included in the terrestrial effects analysis (table 57). The analysis is also based on land management plan direction and projected changes in quality habitat under the alternatives.

Information on species, their population trends, and habitat trends presented in this analysis is incorporated into the terrestrial wildlife specialist report. Analysis of MIS for the Tonto National Forest Forestwide MIS report (USDA FS 1985a) is also incorporated by reference. For more in-depth discussions of habitat types and species selection as well as forest wide population trends, see the Wildlife Specialist Report (USDA FS 1985a).

A discussion of habitats and bird species found in these habitats is included in the terrestrial wildlife specialist report.

Table 57. Terrestrial management indicator species (MIS) or focal species analyzed

Management Indicator Species	Forest(s)	Key MIS Habitat Component Indicator	Habitat within Project Area
Northern goshawk (<i>Accipiter gentilis</i>)	Tonto	Late-seral ponderosa pine	Ponderosa pine
Pygmy nuthatch (<i>Sitta pygmaea</i>)	Tonto	Late-seral ponderosa pine	Ponderosa pine
Turkey (<i>Meleagris gallopavo merriami</i>)	Tonto	Late-seral ponderosa pine, mixed conifer	Ponderosa pine

Management Indicator Species	Forest(s)	Key MIS Habitat Component Indicator	Habitat within Project Area
Rocky Mountain elk (<i>Cervus elaphus</i>)	Tonto	Early seral ponderosa pine, mixed conifer, and spruce-fir	Ponderosa pine, mixed conifer
Hairy woodpecker (<i>Picoides villosus</i>)	Tonto	Snags in ponderosa pine, mixed conifer and spruce-fir	Snags in ponderosa pine
Abert's squirrel (<i>Sciurus aberti</i>)	Tonto	Early seral ponderosa pine	Ponderosa pine
Violet green swallow (<i>Tachycineta thalassina</i>)	Tonto	Ponderosa pine; mixed conifer cavities	Ponderosa pine; Mixed conifer
Ash-throated flycatcher (<i>Myiarchus cinerascens</i>)	Tonto	Pinyon-juniper woodland	Pinyon-juniper
Gray vireo (<i>Vireo vicinior</i>)	Tonto	Pinyon-juniper woodland	Pinyon-juniper
Townsend's solitaire (<i>Myadestes townsendi</i>)	Tonto	Pinyon-juniper woodland	Pinyon-juniper
Juniper (Plain) titmouse (<i>Baeolophus ridgwayi</i>)	Tonto	Pinyon-juniper woodland	Pinyon-juniper
Northern (Common) flicker (<i>Colaptes auratus</i>)	Tonto	Pinyon-Juniper woodland (snags)	Pinyon-Juniper
Arizona gray squirrel (<i>Sciurus arizonensis</i>)	Tonto	Riparian-High Elevation (3000 feet plus)	General Riparian
Western bluebird (<i>Sialia mexicana</i>)	Tonto	Forest openings in ponderosa pine/mixed conifer type	Ponderosa pine-oak, mixed conifer
Western wood peewee (<i>Contopus sordidulus</i>)	Tonto	Riparian-High Elevation	Riparian tall overstory
Black hawk (<i>Buteogallus anthracinus</i>)	Tonto	Riparian-High Elevation	Riparian tall overstory

Important Bird Areas

The Mogollon Rim Snowmelt Draws Important Bird Area is the only one within the project area. It covers approximately 72,162 acres and encompasses drainages located within eight kilometers of the edge of the Mogollon Rim, an abrupt cliff that represents the southern extension of the Colorado Plateau. This edge of the Rim has a narrow band of moist vegetation (especially maples) associated with greater precipitation formed by the upward deflection of air at the rim face. The habitat of this bird area includes ponderosa pine, white fir, Douglas fir, southwestern white pine, quaking aspen, and Gambel oak. Young plants of these canopy trees, plus canyon maple and New Mexico locust, dominate the understory woody species.

See the Arizona Important Bird Areas Program website for more information at <http://aziba.org>.

About 45,673 acres of habitat would be treated within the project area, equaling about 61 percent of the Important Bird Area. While most acres proposed for treatment are within ponderosa pine habitat, treatments in the Important Bird Area would also occur in mixed conifer, aspen and oak/maple habitats. In addition, road decommissioning, restoration of springs, and over 30 miles of riparian restoration activities are proposed within the area.

Other Species of Concern

Locally Important Species

The land management plans of the Rim Country forests provide desired conditions and guidelines for the protection of locally important species on each of the forests. Most of the terrestrial species considered rare and endemic on the forests are outside the Rim Country project area. No further documentation is

required for the following species except for the Arizona black rattlesnakes and Arizona toad (see terrestrial wildlife specialist report).

Assumptions and Methodology

Best Available Science

This analysis is based on best available scientific information. Data sources include research and life history literature and technical reports (see Reference section), land management plan standards and guidelines, participation of researchers and managers from other agencies (as cited in the terrestrial wildlife specialist report), approved survey protocols, professional judgment, and the integration of other specialist reports for this project (silviculture, fire and air quality, soils and watershed, and transportation) to determine effects on wildlife species and their habitats (see project record for additional information). The Rim Country interdisciplinary team developed spatially-defined databases for use in a Geographic Information System (GIS) from which the majority of the data and information contained in the terrestrial wildlife specialist report were derived. This database includes variables related to forest structure and forest health (such as, wildlife habitat such as snags, downed logs, tree density, size classes, and species, old growth, wildlife habitat classifications, and understory biomass index (see project record for additional information)). See the silviculture, fire ecology, and air quality specialist reports for details on the metrics used and their respective modeling approaches, definitions, and assumptions.

Climate Change

The Climate Change Vulnerability Assessment for the Coconino National Forest and Rim Country project area (USDA FS 2017) identifies that 60 percent of the Rim Country project area is at moderate vulnerability, and 13 percent is at high vulnerability. At the ecological response unit level, 50 percent of the mixed conifer was rated as very high vulnerability or risk of type conversion. Eighty-eight percent of the ponderosa pine ERUs were rated as high vulnerability.

The change in understory structure and palatability affects a wide array of wildlife from elk to arthropods, including a suite of prey species for northern goshawks and Mexican spotted owl. Climate change is predicted to lead to changes in fire patterns, increased evaporation and drought stress, reduced snowpack, and alteration of hydrologic timing and quantity, and can even lead to species extinctions (Marlon et al. 2009 and USFWS 2021c).

Certain habitats are more vulnerable to a changing climate. For example, springs are a valuable natural water source for a variety of birds and mammals, particularly in arid environments. These areas may offer critical refugia for rare and narrow endemic species. However, many springs in the Rim Country project area are sensitive to variable precipitation and likely to dry up during prolonged drought. Along with increases in summer temperatures, climate change effects may make it harder for some riparian and wetland species to survive and challenge efforts to reintroduce some species into their historic range (Committee on Environment and Natural Resources 2008).

Recent work locally that focused on the 4FRI landscape supported these findings. Implementation of the proposed Rim Country Project activities would be in alignment with these recommendations.

Spatial and Temporal Scales

Effects on species and their habitats were evaluated at multiple scales. Depending on the species and specific analysis, this could include the site (based on stand data), watershed, ecological response unit, and/or individual forest. Data used was generated from modeling identified in the Silviculture Report. The timeframe for short-term effects is after treatment (20 years), representing conditions after all tree cutting and tree removal occurs, followed by prescribed fire in the 10 years during treatment and after 20 years.

The timeframe for short-term effects associated with aspen treatment is when tree cutting is complete and after 10 years of treatment (when one prescribed fire has been conducted). The timeframe for long-term effects is 30 years after treatment.

Whenever possible, species-specific habitat and locality data were used. Additionally, data queried by potential natural vegetation type (PNVT) and land management plan management area (Tonto National Forest) or desired conditions (Coconino and Apache-Sitgreaves National Forests) were used to help with analysis of effects on species' habitats.

Data is typically rounded to the nearest 10 acres, mile, or percentage. Most values have been rounded from their actual decimal values. Totals were calculated before any values were rounded in order to give the most accurate sum. Rounding may have been applied to text discussions and calculated variables reported in tables in the Terrestrial Wildlife Specialist report.

Roads for Hauling Forest Materials in Wildlife Habitat

The Transportation Report assumes that nearly all of the existing roads in the Rim Country project area may at some point in time be used to provide access for a variety of restoration activities, including hauling of forest products resulting from mechanical treatments.

It is proposed in the Tonto Travel Management Plan that 354 miles of ML2 roads be converted to motorized trails. These have received minimal maintenance over the years and their current condition is not anticipated to improve (narrowing, roughening up, or otherwise modifying the road as it's redefined to a motorized trail). Full-size vehicles would be authorized to use these routes under Travel Management and they would be managed as motorized trails. A motorized trail is defined as "a route 50 inches or less in width or a route over 50 inches wide that is identified and managed as a trail." It is anticipated that pre-haul maintenance is all that would be needed in the future to prepare the motorized trails for use to access areas to be treated.

Condition-based Management Approach for Mechanical Treatments

Appendix D of the FEIS contains the Condition-based Management approach for mechanical treatments. The proposed approach builds on the methods used in the first 4FRI EIS, but expands upon it to give the desired flexibility in mechanical treatments in areas with or without other management constraints (such as Mexican spotted owl and northern goshawk habitat, or sensitive soils).

Analysis Methods to Evaluate Environmental Consequences from Alternatives on Mexican Spotted Owl Habitat

Key features of Mexican spotted owl habitat described in the Recovery Plan include Primary Constituent Elements of habitat important to the Mexican spotted owl such as:

- A range of tree sizes and ages with a preponderance of trees greater than 12 inches in diameter,
- basal area and density of pine,
- Canopy cover and structure,
- Tree sizes suggestive of uneven-aged management, and
- Large dead trees (snags) with a diameter of 12 inches or greater.

Mexican spotted owl populations are influenced by prey availability. Key features of prey habitat include:

- High volume of fallen trees (mid-point diameter of 12 inches or greater) and other woody debris
- Plant species richness, including woody species

- Residual plant cover to maintain fruits, seeds, and regeneration to provide needs of Mexican spotted owl prey species, and
- Other improvements to prey habitat

These forest structure elements are reflected in the evaluation criteria and are used to describe the existing condition of the habitat and the effects of the proposed activities according to forest vegetation simulator modeling over a thirty-year period from the existing condition to 10 years and 20 years into the future, after the proposed treatments have occurred. See the Key forest vegetation simulator Habitat Variables Modeled Important to the Mexican spotted owl table in the wildlife specialist report for a full summary of forest vegetation simulator modeling.

- Acres treated and improved by habitat/vegetation type by alternative within Mexican spotted owl habitat type (protected and recovery habitats).
- Changes in basal area by tree size-classes to show effects from uneven-aged management by alternative within Mexican spotted owl habitats.
- Changes in Canopy Cover, changes to Trees Per Acre greater than 18 inches, and increases of large tree size classes greater than 18 inches diameter at breast height by alternative in Mexican spotted owl habitats.

To analyze the effects of alternatives on snags, downed logs, and coarse woody debris the following habitat variables were modeled and reviewed:

- Change in number of snags per acre with a diameter of 12 inches and greater by alternative in Mexican spotted owl habitats (average number of snags 12 to 18 inches, 18 to 24 inches, and greater than 24 inches in diameter).
- Change in tons per acre of coarse woody debris surface fuel three inches or greater.

To analyze the effects of alternatives on understory to provide Mexican spotted owl prey habitat measures in Mexican spotted owl habitats the following variables were modeled and reviewed:

- Snags per acre greater than 12 inches (average of snags 12 to 18 inches, 18 to 24 inches, and greater than 24 inches) and coarse woody debris in Mexican spotted owl habitats.
- Changes in tons per acre of shrub and herbaceous biomass (to maintain fruits, seeds, and regeneration to provide needs of Mexican spotted owl prey species) in Mexican spotted owl habitats.

To analyze the effects of fire by alternative in Mexican spotted owl habitats the following variables were modeled and reviewed:

- Changes in tons per acre by alternative of total surface fuel.
- Changes in potential fire behavior (fire hazard index) by alternative in Mexican spotted owl habitats.
- Changes in risk of crown fire by alternative and Mexican spotted owl habitats.

Fire Modeling Methods To analyze the effects of fire by alternative in Mexican spotted owl habitats the following variables were modeled and reviewed:

- Changes in tons per acre from the proposed action of total surface fuel (from forest vegetation simulator model runs) in Mexican spotted owl habitats (protected activity center which includes the

nest core areas, recovery nest/roost, recovery foraging-dispersal, and Mexican spotted owl critical habitat).

- Changes in potential fire behavior (Fire Hazard Index) modeled from the proposed action in Mexican spotted owl habitats.
- Risk of crown fire modeled from the proposed action in Mexican spotted owl habitats.

Implementation in Mexican spotted owl habitat will follow these guidelines:

- Silvicultural prescriptions will follow the Revised Recovery Plan recommendations with the goal to improve habitat for the Mexican spotted owl and provide protection from high-severity wildfire.
- No trees greater than 18 inches will be cut in protected activity centers or nest/roost recovery habitat unless it is a hazard to operators.
- Prescribed burning is the only treatment that will occur in nest core areas. All the core areas in protected activity centers proposed for treatment will be treated with prescribed fire without mechanical treatment as per the revised Mexican spotted owl Recovery Plan recommendations (USDI 2012).

The number of protected activity centers proposed for treatments and the acreage displayed is not additive. Some protected activity centers have multiple types of treatments (mechanical equipment for thinning, comprehensive restoration prescribed burning).

Seventy-seven protected activity centers (11,258 acres) have mechanical treatments with prescribed fire to thin and remove vegetation proposed in them from Rim Country 4FRI, or for hand thinning to remove vegetation on 1,190 acres (12,448 total acres). District specialists including Wildlife Biologists, Timber Specialists, Silviculture Specialists, and Fire Specialists reviewed the protected activity centers to determine the priority status from risk of wildfire (High, Medium, Low, and No Risk/Inaccessible) and a temporal rating, indicating when the protected activity center would most likely have treatments implemented (Temporal Rating (1= 1-5 years 2= 5-10 years 3= 10-20 years)).

The environmental baseline condition for each of these protected activity centers describing thinning and burning actions from the past 20 years, including wildfires in the protected activity centers and 1/2-mile buffer around the protected activity centers, are described and mapped in the protected activity center Atlas descriptions included in the Biological Assessment (BA). The PAC Atlas is not available to the public because sensitive nest and roost locations are included. The protected activity centers in the project area are included in the proposed action and baseline condition maps. These 72 protected activity centers with mechanical treatment and 5 with hand thinning only proposed also have a narrative in the descriptions of treatment, describing specific activities with a justification for why managers feel treatments are necessary to protect and promote Mexican spotted owl habitat (Rim Country BA).

Five (5) PACS have hand thinning and prescribed fire proposed (1,190 acres). Four (4) of these also have comprehensive restoration treatments proposed within the protected activity center.

Comprehensive restoration using mechanical equipment is proposed in 62 PACs along with prescribed burning. Mechanical equipment for comprehensive restoration without prescribed burning is proposed within 26 PACs. Design features would be practiced reducing effects to the habitat and the species where this occurs (see analysis of effects section for Comprehensive Restoration).

Prescribed burning only (no mechanical treatment prior to burning) is proposed in portions of 177 protected activity centers (80,898 acres; 67 percent of the total protected activity center acres in the

project area) as the implementation tool, including the protected activity center core areas. An additional 1,356 acres would use prescribed fire only for comprehensive restoration in 26 protected activity centers. Additionally, eleven (11) protected activity centers (6,478 acres) do not have any Rim Country related activities proposed and are only included in the analyses of effects to the Mexican spotted owl and Mexican spotted owl critical habitat because they are in the project area.

Proposed Treatments in Mexican spotted owl Recovery Habitat

In Mexican spotted owl Nest/Roost recovery habitat, mechanical treatment with prescribed fire is proposed for 26,401 acres (69 percent of the total 38,092 Nest/Roost recovery habitat within the project area); which includes 23,813 acres of mechanical treatment implementing a silvicultural treatment that follows recovery plan recommendations for Mexican spotted owl Nest/Roost habitat, and 1,636 acres of Comprehensive Restoration proposed. Prescribed fire only is proposed on an additional 3,174 acres.

In Mexican spotted owl Foraging/Non-breeding dispersal recovery habitat mechanical treatment with prescribed fire is proposed for 130,271 acres (71 percent of the 183,686 total Foraging/Non-breeding recovery habitat within the project area); which includes 125,998 acres of mechanical treatment following Mexican spotted owl Recovery Plan recommendations and 3,355 acres of Comprehensive Restoration proposed.

Effects Analyses for Nest/Roost and Foraging/Non-breeding recovery habitat is included below in Analysis of Effects to the Mexican spotted owl, Vegetation Changes. Forest Vegetation System (forest vegetation simulator) model runs are discussed with effects modeled 10- and 20-years of implementation for habitat variables important to the Mexican spotted owl and Mexican spotted owl critical habitat.

Environmental Consequences

Environmental consequences consist of species analyses, beginning with federally threatened and endangered species followed by Forest Service sensitive species, management indicator species, migratory birds, and effects on Important Bird Areas. Following the analysis of direct and indirect effects for each species group is a review of cumulative effects.

Effects from Tonto Land Management Plan Amendment

The analysis for the 1985 Tonto National Forest Land Management Plan proposed amendment for alternatives 2 and 3 is within the analyses below for terrestrial species, though not specifically identified and in appendix B of the FEIS.

Effects from Climate Change

Alternative 1 – No Action

Alternative 1 would not prevent, delay, or ameliorate predicted effects from climate change. The dense forest conditions resulting from alternative 1 are at a high risk to density-related and bark beetle mortality and have limited resilience to survive and recover from potential large-scale fire events and the interactions of these influences with climate change. Under drier and warmer weather conditions, the potential effects of these risks on the ecosystem would be increased. Individual tree growth would be limited to the point of stagnation. As tree density increases, many areas would experience higher mortality. Species requiring closed canopy forest conditions or old or large tree, snag, and log structure would be negatively affected in the long term. Patches of open forest, savanna, and meadow and grassland habitats would potentially increase in the long term as groups of dense forest succumb to the above mortality agents.

Alternative 2 – Modified Proposed Action and Alternative 3 – Focused Restoration

Risks associated with dense forest conditions would be reduced and resilience to the effects from large-scale disturbance under drier and warmer conditions would be improved by implementing the proposed treatments. Individual tree growth rates would improve, creating and retaining more large and old trees. Habitat elements associated with closed canopy forest conditions would be reduced, but would be more sustainable. Risk from insects, fire, and their interactions with climate would be reduced. Because of law, regulation, and policy, more closed canopy habitat would be available than what likely occurred historically. Ensuring the growth and retention of large trees would maintain large snag and log structure across the forest over time. Open forest, meadow, savanna, and grassland habitats would be enhanced and habitat effectiveness increased as encroaching trees were removed and habitat for grassland and pollinator species became less fragmented. These habitats would remain stable in the long term. The increased acres of mechanical and prescribed fire under alternative 2 would realize the most benefit in terms of forest health and resiliency. The limited acres of treatment under alternative 3 would be expected to maintain higher fuel loadings, resulting in more limited gains in forest resiliency due to increased flame lengths, lower canopy base height, and persistent ladder fuels. Alternative 3 would retain the densest forests and therefore achieve the least in terms of large tree growth rates and resilience.

Cable Operations

Cable operations are proposed for Rim Country. Under alternative 2, cable operations could occur on 54,609 acres. Under alternative 3, cable operations could occur on 40,298 acres. No cable operations are proposed in Mexican spotted owl protected activity centers per design feature WL016. Effects to other wildlife species from cable operations would include short-term disturbance from increased noise and activity, followed by long-term benefits of restoration of habitat. Benefits expected are increased foraging opportunities for ungulates, increased movement due to restoring over encroached forest habitat, and reduction of high-severity wildfire risk.

In-Woods Processing Sites

The 12 processing sites are proposed for use in the Rim Country project area and design features (appendix C) and initial placement would avoid effects to the Mexican spotted owl and northern goshawk (see terrestrial wildlife specialist report).

Rock Pits

In order to provide adequate sources of road surfacing material, 11 rock pits would be needed to be utilized and expanded within the project area (See terrestrial wildlife specialist report). All rock pits are either greater than ¼ mile away from a Mexican spotted owl protected activity centers or would have seasonal operating restrictions (see design features) to avoid effects to Mexican spotted owls. All rock pits are located outside of northern goshawk PFAs. Design features (appendix C of the FEIS) would protect other wildlife species and natural resources from disturbance at rock pits.

Federally Listed Threatened, Endangered, Proposed, and Candidate Species and Critical Habitat

Mexican Spotted Owl (Threatened)

Treatments in Mexican spotted owl habitat were modeled using forest vegetation simulator by the 4FRI silvicultural specialist showing habitat variables in ponderosa pine-oak, and mixed conifer cover types, as well as using the geophysical model (Tonto National Forest recovery habitats) important to the Mexican spotted owl with modeled results in the existing condition, 10 years into the future, and 20 years into the future post treatment to show effects from treatments through time.

Alternative 1 – No Action

This alternative proposes no restoration treatments, but habitat variables are modeled the same as for alternatives 2 and 3 (see tables in the wildlife specialist report). See alternatives 2 and 3 habitat restoration in Mexican Spotted Owl Habitat section below.

The no action alternative includes no new mechanical treatments or prescribed fire in Rim Country in any habitat, including ponderosa pine, ponderosa pine-oak, aspen, meadows, springs, riparian areas, and streams. No road construction, maintenance, or decommissioning would occur within the project area. None of the associated wildlife habitats would be restored or moved toward restoration.

Alternative 1 Protected Habitat

Forest Structure

In protected activity centers after 20 years of no management, average basal area and canopy cover increases. With no action, protected activity centers would show an increase in coarse woody debris and snags greater than 12 inches in diameter. While creation of large snags would continue, the decreasing numbers of large trees through time would maintain a deficit of large snags 20 years into the future. Pulses of large snag creation may occur at any time because of fire, insects, and disease. Increases in large snags as an outcome of stochastic events would result in decreases of large trees.

Small mammal habitat would be maintained through time in terms of logs and coarse woody debris (cover for prey species) under this alternative. However, accumulated coarse woody debris could decrease Mexican spotted owl habitat effectiveness (Roberts et al. 2011). Herbaceous biomass in tons per acre (food for prey species) and shrub biomass in tons per acre (cover for prey species) would decrease in both the short term and long term under alternative 1. However, canopy development combined with a lack of fire and increased needle accumulation would cause a continued decline in understory through time. The continued loss and fragmentation of understory vegetation would limit invertebrate populations, including pollinators. If this pattern continued over time, a cascading effect could occur as arthropod species richness and abundance declines, increasing the rate of decline in understory biomass and potentially causing an additive effect to Mexican spotted owl prey species. Combined decreases in understory vegetation and associated arthropod communities could affect Mexican spotted owl directly (lack of flying insects as prey) and indirectly (food availability for prey species such as mice, voles, birds, and bats). Understory vegetation would remain at low levels of productivity and would continue to decrease through time, except in areas where fire, insect, or disease opened the canopy.

While the no action alternative appears to have some benefits for habitat variables important to the Mexican spotted owl, surface fuel loading is increased by 6 tons per acre in protected activity center habitat in each cover type, mixed conifer and ponderosa pine-oak. Under alternative 1, the protected activity centers in the Rim Country project area are at a much higher risk of severe effects from wildfire.

As shown in tables 12 and 13 of the terrestrial wildlife specialist report, the average of all basal areas, from the sapling Size Class 1 to old growth Size Class 6 shows that intermediate-sized trees in both cover types, mixed conifer and ponderosa pine-oak (Size Class 3 with basal area of 5 to 12 square inches and Size Class 4 with a basal area of 12 to 18 square inches) would be predominant on the landscape and vastly departed from the natural range of variation and would not be lowered to the desired condition, a result of no treatments after 20 years.

Alternative 1 Nest/Roost Recovery Habitat

Forest Structure

In nest/roost recovery habitat after 20 years of no management, average basal area and canopy cover increases. Snags are maintained or decreased. Course woody debris increases, and the shrub and herbaceous layers are maintained or decreased. While the no action alternative appears to have some benefits for habitat variables important to the Mexican spotted owl, surface fuel loading is increased by 8 tons per acre in nest/roost recovery habitats habitat in each cover type, mixed conifer and ponderosa pine-oak. This places the nest/roost recovery habitat in the Rim Country project area at a much higher risk of severe effects from wildfire.

In nest/roost recovery habitat, the average of all basal areas from the sapling Size Class 1 to old growth Size Class 6 shows that intermediate-sized trees in all cover types, mixed conifer, ponderosa pine-oak, and for acres identified using the Geophysical model (Size Class 3 with a basal area of 5 to 12 square inches and Size Class 4 with a basal area of 12 to 18 square inches) would be predominant on the landscape and vastly departed from the natural range of variation and would not be lowered to the desired condition, a result of no treatments after 20 years.

Alternative 1 Foraging/Non-Breeding Recovery Habitat

Forest Structure

In foraging/non-breeding recovery habitat after 20 years of no management, average basal area and canopy cover increases. Snags are maintained or decreased. Course woody debris increases, and the shrub and herbaceous layers are maintained or decreased. While the no action alternative appears to have some benefits for habitat variables important to the Mexican spotted owl, surface fuel loading is increased by 8 tons per acre in foraging/non-breeding recovery habitat in each cover type, mixed conifer, ponderosa pine-oak, and for acres identified using the Geophysical model. This places the Foraging/Non-breeding recovery habitat in the Rim Country project area at a much higher risk of severe effects from wildfire.

In foraging/non-breeding recovery habitat, the average of all basal areas from the sapling Size Class 1 to old growth Size Class 6 shows that intermediate-sized trees in all cover types, mixed conifer, ponderosa pine-oak, and for acres identified using the geophysical model (Size Class 3 with a basal area of 5 to 12 square inches and Size Class 4 with a basal area of 12 to 18 square inches) would be predominant on the landscape and vastly departed from the natural range of variation and would not be lowered to the desired condition, a result of no treatments after 20 years.

Alternative 1 Fire Effects

Surface Fuel Loading

Surface fuel loading in Mexican spotted owl protected habitat would increase under alternative 1, moving from an existing 26 tons per acre in mixed conifer and 19 tons per acre in ponderosa pine-oak to 32 tons per acre in mixed conifer and 25 in ponderosa pine-oak after 20 years of no management. Land management plans call for fuel loading in tons per acre of 5 to 15 tons in mixed conifer and 3 to 10 trees per acre in Ponderosa pine oak cover types. The forest vegetation simulator modeling shows that after 20 years of no treatment these fuel loads are more than double the desired conditions in this habitat type. Increased surface fuel loading would place the protected activity centers at a much higher risk of uncharacteristically severe wildfire than would naturally occur.

Surface fuel loading in Mexican spotted owl nest/roost recovery habitat would be increased under alternative 1, moving from 28 tons per acre in mixed conifer, 18 tons per acre in ponderosa pine-oak, and 23 tons per acre in geophysical model, to 35 tons per acre in mixed conifer, 25 tons per acre in ponderosa pine-oak, and 28 tons per acre in geophysical model after 20 years of no management. The forest vegetation simulator modeling shows that after 20 years of no treatment, these fuel loads are more than

double the desired conditions in this habitat type. Increased surface fuel loading would place the nest/roost recovery habitat at a much higher risk of uncharacteristically severe wildfire.

Fire Hazard Index

The moderate, high, and extreme need for treatment categories of fire hazard index are increased from alternative 1 in protected activity centers from the existing condition of 70,328 acres (62 percent) to 75,393 acres (65 percent) after 20 years. The high and extreme need for treatment categories are increased from 51,002 acres (45 percent) of all protected activity centers modeled in the existing condition to 58,107 acres (50 percent) after 20 years under alternative 1.

In nest/roost recovery habitat the moderate, high, and extreme need for treatment categories of fire hazard index are increased in alternative 1 from 22,628 acres (60 percent) in the existing condition to 23,863 acres (62 percent) after 20 years. The high and extreme need for treatment categories are increased from 15,869 acres (42 percent) of all nest/roost recovery habitat modeled in the existing condition to 18,071 acres (48 percent) after 20 years.

Under alternative 1, in foraging/non-breeding Mexican spotted owl recovery habitat the moderate, high, and extreme need for treatment categories of fire hazard index are increased from 84,363 acres (46 percent) in the existing condition to 90,447 acres (50 percent) after 20 years. The high and extreme need for treatment categories are increased from 51,210 acres (28 percent) of all foraging/non-breeding recovery habitat modeled in the existing condition to 60,578 acres (34 percent) after 20 years.

Risk of Crown Fire

In protected activity centers, the potential for active and conditional crown fire is increased in alternative 1 compared to the existing condition from 58,765 acres (51 percent) to 62,205 acres (51 percent) of this habitat type. These areas would experience high-severity crown fire as a result of no management. Active crown fire risk is increased from 39 percent of all protected activity center habitat in the project area to 49 percent after 20 years.

In nest/roost recovery habitat, the potential for active and conditional crown fire is increased in alternative 1 compared to the existing condition from 18,275 acres (48 percent) to 19,358 acres (51 percent) after 20 years of no action. Active crown fire risk is increased from 39 percent of all nest/roost recovery habitat in the project area to 48 percent after 20 years.

In foraging/non-breeding recovery habitat, the potential for active and conditional crown fire is increased in alternative 1 compared to the existing condition from 63,737 acres (34 percent) to 67,600 acres (37 percent) after 20 years of no action. Active crown fire risk is increased from 27 percent of all foraging/non-breeding recovery habitat in the project area to 35 percent after 20 years.

Alternative 1 Other Habitat Effects

Springs, Riparian and Stream Habitat, Grasslands, Savannas, Meadows, and Aspen: Under alternative 1, no springs or riparian habitat would be restored. One hundred eighty-four springs and associated prey habitat would remain in degraded condition within the project area, with many included in protected activity centers. Similarly, wildlife habitat associated with almost 171 miles of riparian stream channels would remain in degraded condition within Mexican spotted owl habitat. The grasses, forbs, and shrubs that could potentially occupy these sites would remain absent or limited in both species richness and abundance.

No grassland, savanna, or meadow treatments would occur, resulting in nearly 350 acres in protected activity centers and over 60,390 acres of this important habitat continuing to degrade as a result of pine

tree encroachment in Mexican spotted owl habitat. This would represent a decline in the quantity and quality of habitat for grassland associated species, including obligate migratory and sensitive avian species. As food and cover decline for small mammals, potential source populations of important Mexican spotted owl prey species would be expected to decline in the long term. Overall, the landscape would move toward homogeneity as ponderosa pine continued to compromise or eliminate these key sources of heterogeneity.

Unique wildlife habitat features associated with 1,230 acres of aspen would decline or vanish as losses continued. Conifer trees would gradually succeed aspen trees through competition for space, light, and water, which is a major cause of aspen decline (Johnson 2010). Associated declines in regional avifauna would occur as a result of habitat loss (Griffis-Kyle and Beier 2003). The rate of avian decline could increase as habitat changes favored nest predators (Johnson 2010). Understory biomass, which provides the food and cover to support Mexican spotted owl prey species (for example, small mammals, birds, and arthropods), would decrease exponentially as conifer cover increased (Stam et al. 2008).

The effects of these microhabitats are greater than their combined total acres. This is particularly relevant when these patches of heterogeneity occur in protected activity centers where Mexican spotted owls disproportionately forage during the nesting season.

Roads: Under the no action alternative, no new restoration activities would take place and no additional use of existing roads would occur. Current rates of public and administrative use would continue. Maintenance to provide public and administrative access would continue, contingent upon funding. No increase in road maintenance to accommodate restoration activities would occur. No temporary roads would be constructed, but also no road decommissioning, unless they are analyzed under separate NEPA analyses.

Alternative 1 Direct and Indirect Effects

With no treatments occurring, there would be no direct increase or decrease in habitat quality of Mexican spotted owl protected, recovery, or critical habitat in the short term. In the long term, Mexican spotted owl habitat quality would decrease as a result of declines in forest health and resiliency.

The lack of mechanical thinning and low-severity prescribed fire would allow the current forest trajectory to continue. Dense forests would maintain closed canopy conditions but continue to exhibit reduced growth rates. The abundance of young and mid-aged forest would continue to dominate the landscape because of stagnating growth rates and competition-induced mortality of large trees. Gambel oak, aspen, and meadows would decline as pine encroachment continued. Spring function would decline as would reaches of riparian habitat channels. Competition for limited water and nutrients would continue and would increase in time as snowpack decreases with developing climate change.

This alternative would not reduce the threat of high-severity fire, which is a primary concern for the recovery of this species. Surface fuels would continue to increase and understory vegetation would decrease or remain the same. Alternative 1 would not contribute to improving forest health or vegetation diversity and composition, sustaining old forest structure over time, or moving forest structure toward the desired conditions.

No additional disturbance from noise, smoke, or other aspects of implementation activities would occur under this alternative.

Alternative 1 Determination of Effect

Based on the above analysis, alternative 1 of the Rim Country Project **may affect, is likely to adversely affect the Mexican spotted owl.**

Effects Common to Both Action Alternatives

Environmental consequences are described by Mexican spotted owl habitat type (for example, protected and recovery) and designated critical habitat. Proposed treatments are similar across Mexican spotted owl habitat types, although the degree to which they are implemented would vary depending on specific stand conditions. Modeled results are based on stand-specific outputs and represent the variability in treatment implementation. The objectives of the treatments are to increase tree growth rates, retain large pine and oak trees, and increase forest resiliency. Recovery nest/roost habitat would be managed to maintain or achieve nest/roost conditions sooner than if they were not treated. Forest conditions in nest/roost habitat would remain at or above nest/roost values after treatments as shown in table C.3 of the Recovery Plan.

The objective of the Rim Country treatments in Mexican spotted owl habitat is to improve forest structure for owls as defined in the recovery plan per the condition-based management approach for mechanical treatments (appendix D). This is different from an emphasis on fuels reduction. Large trees would be retained, and targeting mid-aged trees would improve the health, growth rates, and sustainability of large trees. Certain habitat and stand structures warrant additional consideration. For example, some Mexican spotted owl habitat and certain stand conditions require consideration of additional management constraints before prescribing treatments. protected activity centers exhibit a variety of topographic and forest conditions and occupied protected activity centers can already be considered successful nesting habitat. Mechanical treatments in protected activity centers would be designed to maintain or improve the characteristics that make each protected activity center effective at providing habitat while also making them resilient to disturbance. Consideration should be given to:

- increasing the number of large trees
- creating additional foraging habitat for Mexican spotted owl
- the fire hazard index in the protected activity center and whether it is in wildland-urban interface
- restoration and protection of other resource values nearby, such as perennial water
- protecting other values at risk

Treating areas near protected activity centers should be considered in order to improve resiliency in the protected activity centers themselves. Protected activity centers should be treated with consideration of the larger landscape and not just separate entities. Specific treatments in protected activity centers would be determined prior to implementation and in consultation with U.S. Fish and Wildlife Service (FWS) personnel. In nest/roost recovery habitat, the condition-based management approach for mechanical treatments (appendix D) states that, though recovery nest/roost habitat is distinct from protected activity centers, their management objectives are similar. Any treatment proposed in Mexican spotted owl nest/roost recovery habitat should be designed specifically to maintain or accelerate the trajectory of these stands toward desired habitat conditions in the foreseeable future. Achieving management objectives within Mexican spotted owl foraging or other recovery habitat can be addressed with the condition-based management approach. Stands in recovery habitat would be assigned a treatment using the decision matrices; however, additional management direction would be applied such as maintaining increased basal area (40 to 110 square feet of basal area for ponderosa pine-oak and 40 to 135 square feet of basal area for mixed conifer). This additional guidance is included in the project design features to ensure resource protection (see appendix C).

Alternatives 2 and 3 Habitat Restoration in Mexican spotted owl Habitat

A total of 214 protected activity centers (120,522 acres) occur in the Rim Country project area. An additional 39,748 acres either fall outside of the Rim Country project area (11,269 acres) or occur in other project areas (28,479 acres). These 39,748 acres would be treated as those projects planned and consulted with USFWS, except for the protected activity centers that are in the Clint's Well, Upper Beaver Creek; and Rim Lakes project areas. These are included in this analysis for the Mexican spotted owl to

accommodate for recent protected activity center boundary changes conducted with USFWS in these project areas and to allow for prescribed fire within nest cores.

The 4FRI interdisciplinary team met with USFWS to understand how acres of protected habitat would be selected for mechanical treatments. The interdisciplinary team worked with district wildlife biologists, fire/fuels specialists, silviculture and timber specialists from all three national forests, and reviewed each protected activity center for treatment needs. Protected activity centers were assessed in terms of dominant forest type (such as ponderosa pine-oak, mixed conifer, or canyons), habitat structure, available demographic data (based on ongoing occupancy surveys or past research), topographic attributes (such as aspect and slope), human access, designated wilderness boundaries, recent and ongoing projects affecting protected activity center habitat, fire history and risk from wildfire modeling, status of current habitat, and whether mechanical treatments could move the habitat toward the desired conditions described in the Recovery Plan. In accordance with the Recovery Plan recommendation, Rim Country does not propose no mechanical or hand treatments in core areas. Therefore, this is not analyzed.

Once the status of the protected activity center was determined, potential mechanical treatments were considered in terms of whether they could:

- Decrease the amount of time required for growing/increasing tree height and diameter;
- Decrease overall tree density while maintaining the density of large trees,
- Increase canopy base height to improve flight zone (improve owl foraging ability) and also reduce the threat of surface fires becoming crown fires.

In Mexican spotted owl protected activity centers, mechanical treatment is proposed for 11,258 acres (10 percent of total protected activity center habitat in the project area). Hand thinning is proposed on 1,190 acres (see Terrestrial Wildlife Specialist Report). Prescribed fire only is proposed on 80,898 (67 percent) acres of the 120,522 total acres in protected activity centers in the Rim Country project area.

Approximately 140 acres of protected activity center habitat is proposed for facilitative operations treatments. Facilitative operations treatments use mechanical and prescribed fire treatments in pinyon-juniper cover type to support the use of prescribed fire in mixed-conifer and ponderosa pine oak habitat are proposed. Facilitative operations treatments could include mastication/chipping; lop and scatter; thinning/limbing; and moving, rearranging, or removal of jackpots or excessive surface fuels. Facilitative operations treatment areas are designed to improve safety, improve treatment effectiveness, expand burn windows, decrease undesirable fire behavior and effects, and minimize disturbance from fire line construction. Design features would be practiced reducing effects to the habitat and the species where this occurs (see analysis of effects section for Comprehensive Restoration).

Approximately 130 acres area proposed in protected activity center habitat for severe disturbance area treatments (see Terrestrial Wildlife Specialist Report). Severe disturbance area treatments would use a combination of restoration treatments: reforestation, prescribed fire, lopping/scattering, mastication, and other mechanical methods to identify treatments that would be effective in restoring the fuel structure that produces the types of fire to which ponderosa pine is adapted. Design features would be practiced reducing effects to the habitat and the species where this occurs (see analysis of effects section for Comprehensive Restoration).

Comprehensive Restoration Activities within Mexican Spotted Owl Protected Activity Centers and Core Areas

Approximately 2,192 acres (2 percent of total protected activity center habitat in the project area) with mechanical treatment are proposed for comprehensive restoration. Comprehensive restoration treatments can include removing tree(s), tree canopy, or shrub encroachment of upland species with hand thinning,

mechanical thinning, or prescribed fire. Comprehensive restoration using mechanical equipment in Mexican spotted owl habitat would follow design features to reduce effects to the owl and its habitat and to follow Mexican spotted owl Recovery Plan recommendations to promote desired conditions.

Grassland and Meadow Restoration: Approximately 15 acres of grassland restoration and 258 acres of wet meadow restoration are proposed in protected activity centers where this could occur. Grassland and meadow restoration can include mechanical vegetation treatments to remove conifer encroachment. Methods include ground-based logging systems and hand thinning to restore and sustain these habitat types. Design features will be practiced reducing effects to the habitat and the species where this occurs (see analysis of effects section for Comprehensive Restoration).

Riparian and Wet Meadow Restoration: Approximately 1,819 acres of riparian and 101 acres of wet meadow riparian habitat are proposed in protected activity centers where this could occur. Riparian and Wet Meadow Restoration treatments include mechanical vegetation treatments and prescribed fire treatments to remove encroachment using ground-based logging systems, hand thinning, and prescribed fire. Planting desirable riparian species may occur using methods ranging from planting by hand (such as dibble or hoedad) to a skid-steer with an auger. Design features would be practiced reducing effects to the habitat and the species where this occurs (see analysis of effects section for Comprehensive Restoration).

Stream Restoration: Approximately 148.2 miles of general stream restoration and 23.3 miles of heavy mechanical stream restoration are proposed in protected activity centers where this could occur. In core areas general stream restoration could occur on 23.3 miles and heavy mechanical stream restoration could occur on 4.9 miles. The need for stream restoration is to achieve desired conditions as defined by land management plans, species recovery plans or watershed restoration action plans. Desired conditions for streams and aquatic habitats would support native fish and other aquatic species, providing the quantity and quality of aquatic habitat within the natural range of variation. This includes increasing habitat complexity such as pools and large woody debris, reducing downcutting and sedimentation, improving riparian areas that provide channel stability and leaf litter, and stream shading to maintain water temperatures. General stream restoration includes all stream restoration techniques, mechanical restoration is a subset of these methods that involve heavy equipment use. Design features would be practiced reducing effects to the habitat and the species where this occurs (see analysis of effects section for Comprehensive Restoration).

Skid Trails and/or Tracked Harvesters: Skid trails could be needed in protected activity centers and recovery habitats in order to accomplish thinning treatments; however, all would be rehabilitated after harvesting. Ground disturbance from skid trails can cause indirect effects from the loss of vegetation through compaction and rutting and exposure of bare mineral soil. Harvest activities with skid trails could adversely affect the prey base on a short-term basis by affecting individuals of prey species due to disturbance of prey species' habitat. As analyzed by the Rim Country soil scientist,

Mechanical thinning of the ponderosa pine forests of Arizona has been occurring since the 1980s mainly through whole tree harvesting on slopes less than 40 percent. Typical equipment used for such harvesting includes rubber-tired feller bunchers and rubber-tired skidders with tracked dozers used for piling of slash. The amount of disturbance as a percentage of a typical harvest unit (such as, area included in a thinning contract) affected by compaction, rutting, and/or exposure of bare mineral soil from this type of harvesting has been estimated to be roughly 15 percent associated with feller-buncher and skidding operations, three percent associated with machine piling of slash, three percent associated with landings, and three percent associated with temporary roads (MacDonald 2013).

Design features have been incorporated to minimize disturbance from heavy machinery operations, and thus would generally minimize compaction, rutting, and/or exposure of bare mineral soil in these areas.

Roads: Alternatives 2 and 3 are the same in terms of roads proposed to haul material. The main difference is that in alternative 3, temporary roads would be reduced from 330 to 170 miles. It is assumed that nearly all, if not all system roads within the project area could be utilized at some point in time to carry out restoration activities.

Road Maintenance- Roads that would be utilized for restoration work and hauling of forest products would likely see pre-haul maintenance if needed to make the roads passable to truck traffic, as well as maintenance during hauling and post haul maintenance. This maintenance would be in addition to a forest's regular schedule of maintenance.

Road Decommissioning- Up to 200 miles of system road on the Coconino and Apache-Sitgreaves National Forests could be decommissioned. The Tonto National Forest Travel Management EIS has identified approximately 290 miles of road within the Rim Country project area for decommissioning. In addition to system road decommissioning, up to 800 miles of unauthorized roads on all three forests may be decommissioned under this alternative.

Temporary Roads- Under alternative 2, up to 330 miles of temporary road could be utilized to facilitate harvest activities. Under alternative 3, up to 170 miles of temporary road could be utilized to facilitate harvest activities. These temporary roads may be new construction or also utilize existing unauthorized roads. Temporary roads would be decommissioned when thinning and restoration work is completed in the area that they access.

Mechanical Thinning and Prescribed Burning

Alternatives 2 and 3 would follow land management plan direction, including implementing guidelines from the revised Mexican spotted owl Recovery Plan (USDI FWS 2012). Cover types may have all or some of the direction for Mexican spotted owl habitats, depending on location and stand structure. The objective of Rim Country treatments in Mexican spotted owl habitat is to reduce fire hazard while maintaining habitat for Mexican spotted owls as defined in the recovery plan and in the **condition-based management** approach for mechanical treatments (appendix D).

Mexican spotted owl Protected Activity Centers: Potentially thin and burn to improve structure, maintain and develop large trees, and reduce risk of high-severity fire in protected activity centers. No mechanical treatments, but fire may be implemented, in 100-acre core areas. Outside core areas, trees may be thinned and/or prescribed fire implemented where feasible to improve forest structure and minimize undesirable fire effects. Promote irregular tree spacing to create canopy gaps more conducive to treatment with prescribed fire, retain old growth attributes, protect large oaks, and ensure snags and coarse woody debris post-fire. Develop treatments in consultation with USFWS.

Mexican spotted owl Nest/Roost Recovery Habitat: Mechanical and prescribed fire treatments in potential future nest/roost habitat would be implemented following guidelines in Table C3 of the revised Mexican spotted owl recovery plan to provide for owl daily movements, dispersal, and foraging habitat.

In Mexican spotted owl recovery habitat outside of potential future Nest/Roost: Implementation would follow land management plan guidance. The intent would be to continue to develop replacement nest/roost where possible and otherwise treat to develop a diverse mix of heterogeneous stand structures and densities to provide for owl dispersal and foraging. Design features have been added to mitigate disturbance to the Mexican spotted owl from these activities (appendix C of the FEIS).

Because of planning and timing restrictions, noise disturbance to owls is not expected in protected activity center habitat where the majority of foraging is done by nesting owls. Owls foraging outside protected activity centers during nesting season could potentially be displaced by thinning activities and increased

truck traffic. Owls could also be displaced by harvest activities and increased truck traffic outside the nesting season. Displaced owls could be more vulnerable to predation.

Vehicular traffic would not simultaneously increase across the entire implementation area, but harvest-related traffic increases would occur in localized areas somewhere on the landscape for every year of implementation. Most traffic is expected to occur during diurnal hours when Mexican spotted owl activity would be minimal. However, hauling of materials from harvest locations to highways could occur at night when owls are active. Once harvest activities are complete, traffic is expected to return to pre-harvest levels.

The amount of traffic increases the risk of collisions between owls and trucks. There have been documented instances of spotted owls being hit by vehicles on paved and unpaved roads. Although little information is available on the frequency or conditions related to the risk of collisions, the assumption is being made that, because of the scale of increase in truck traffic, the risk of collisions with owls would increase. The threat of collisions would be reduced below existing conditions in the long-term as a result of road decommissioning.

Cable Operations: No cable operations are proposed in Mexican spotted owl (MSO) Protected Activity Centers (PACs) per design feature WL016. Cable operations could occur in Mexican spotted owl Recovery and Critical Habitat. Cable operations can be used to mechanically treat steep slopes that would otherwise be untreatable. Additionally, cable operations have been shown to reduce erosion when compared to ground-based operations (Reeves et al. 2011, Worrell et al. 2011, Schweier and Loduwicy 2020).

While the goal of using cable operations is to reduce erosion effects, cable systems can have increased soil effects in cable corridors and typically denude approximately 3 percent of the area. Typically, there is the need to remove all snags in these areas and cut large trees that fall within the corridors for operator safety. Placement of corridors would seek to avoid snags and large trees to the fullest extent possible and would be coordinated with USFWS during planning and implementation of cable operations (appendix C Design Feature SI019).

Ground disturbance can cause indirect effects from the loss of vegetation through compaction and rutting and exposure of bare mineral soil. Landings, cable corridors, road construction and decommissioning, and other harvest activities could adversely affect the prey base on a short-term basis by impacting individuals of prey species due to disturbance of prey species' habitat.

In Mexican spotted owl recovery habitat large trees greater than 24 inches diameter at breast height and snags would not be targeted for removal except where necessary for cable corridor locations and safety requirements in areas where trees would be felled by hand and removed by cable. The Recovery Plan guidelines are to retain large trees (greater than 18 inches diameter at breast height) in Nest/Roost recovery habitat and retain trees greater than 24 inches diameter at breast height in Foraging/Non-breeding or dispersal recovery habitat. Design features are in place for the Rim Country Project to reflect these recommendations.

In addition, cable logging traditionally requires that all hazard trees be removed from the entire area that would be cable logged to provide for safety of personnel on the ground outside of protected (closed cab) machinery. Placement of cable corridors would seek to cut the fewest large trees possible, however there may be cases where some large trees and snags would be removed within cable corridors. This loss of trees and snags would reduce these key habitat components in recovery habitats thus moving away from desired conditions in corridors and adjacent to corridors.

This alternative would lead to a loss of more Mexican spotted owl key habitat components with a loss of more snags and trees greater than 24 inches diameter at breast height. Although there would be a loss of trees greater than 18 inches diameter at breast height in cable corridors within Nest/Roost recovery habitat and greater than 24 inches diameter at breast height in dispersal recovery habitat when averaged across the cable treatment areas there are still ample large trees to meet the desired conditions in the ponderosa pine and mixed conifer cover types within Mexican spotted owl recovery habitat after treatment. Snags could move further away from desired conditions within the areas treated by cable logging.

Treatments in the Rim Country Project area would be designed to move toward desired conditions as identified in the 2012 Mexican Spotted Owl Recovery Plan (MSO Recovery Plan) (USFWS 2012) with two possible exceptions: (1) trees greater than 18 inches diameter at breast height could be cut for cable corridors and (2) all snags in cable corridors that pose a safety risk adjacent to corridors would also have to be removed.

Cable operations could occur in Mexican spotted owl recovery habitat (5,045 acres in nest/roost recovery, and 25,941 acres in foraging-non-breeding recovery). This treatment type would have short-term effects by reducing the understory under the cables, which could reduce forage and cover, with long-term beneficial effects of increased prey activity, and creation of openings to provide for native grasses and foraging opportunities for owls and other wildlife species. Following the assumption of 3 percent of the area's habitat denuded for the cable corridors, a maximum of 151 acres of Nest/Roost recovery and 778 acres of Foraging/Non-breeding recovery habitat could be denuded. This represents less than 1 percent of these habitat types in the Rim Country Project area (0.39 percent in Nest/Roost recovery and 0.42 percent Foraging/Non-breeding recovery habitat). Adverse effects to key habitat components of recovery habitat, particularly in nest/roost replacement habitat, from cable operations may occur.

New Protected Activity Centers Added Post-Analysis in 2021

Seven new protected activity centers were added to the project area after the Rim Country Project forest vegetation simulator and fire modeling were completed. USFWS consultation for mechanical treatments in these seven newly designated protected activity centers has been accomplished through the past NEPA projects they fall within (Nagel and Rim Lakes on the Apache-Sitgreaves National Forests) or through the Rim Country Project (Tonto National Forest). Effects to all seven of the Mexican spotted owl protected activity centers from the comprehensive restoration and prescribed fire treatments proposed in Rim Country are analyzed in this FEIS and USFWS consultation for these activities is through the Rim Country Project. The terrestrial wildlife specialist report summarizes the new protected activity center acres and core areas and what is proposed in them.

Alternative 2 – Modified Proposed Action

Alternative 2 Mexican Spotted Owl Protected Habitat

In protected activity centers after 20 years of implementation, average basal area is reduced for both mixed conifer and ponderosa pine-oak cover types. In mixed conifer, the average basal area per acre of trees diameter at breast height decreases from 158 square feet to 125 square feet after 20 years of treatments in protected activity centers. Ponderosa pine-oak average basal area per acre is reduced from 144 square feet in the existing condition to 111 square feet. Silvicultural prescriptions would promote growth of large trees and managers should seek to maintain basal areas above the minimum recovery plan recommendations or seek to increase basal area averages. Trees per acre were modeled in protected activity center habitat to show effects from implementation over 20 years. Results show that the number of trees greater than 18 inches in diameter at breast height in the mixed conifer cover type would increase from 18 trees per acre in the existing condition to 20 trees per acre after 20 years of implementation. Results show that in the ponderosa pine-oak cover type, the number of trees greater than 18 inches in

diameter at breast height would increase from 14 trees per acre in the existing condition to 16 trees per acre after 20 years of implementation. Results indicate that both cover types would exceed minimum Recovery Plan recommendations of 12 trees greater than 18 inches in diameter at breast height per acre (Table C3 from the Revised Mexican spotted owl Recovery Plan, 2012). A linear regression from basal area was used to estimate canopy cover (Shephard et al. in Parker et al. 2002). These estimates indicate that treatments would align with Mexican spotted owl recovery plan recommendations (Table C2 from the Revised Mexican spotted owl Recovery Plan, 2012) in mixed conifer with canopy cover of 61 percent, and in ponderosa pine-oak, with canopy cover higher than the recommended 40 percent, measuring 58 percent from implementation of alternative 2.

Shrub and herbaceous biomass would also be maintained or increase in alternative 2. Forest vegetation simulator modeling shows 20 years of implementation risk of crown fire and the fire hazard index would be reduced, while coarse woody debris, downed logs, and snags greater than 12 inches in diameter (with 3 snags greater than 18 inches in diameter in mixed conifer and 1 to 2 snags per acre greater than 18 inches in diameter in ponderosa pine-oak cover type) would be increased in Mexican spotted owl protected habitat.

In mixed conifer 20 years of implementation, trees 12 to 18 inches in diameter at breast height would decrease by one percent from 29 percent in the existing condition to 28 percent, which stays near Mexican spotted owl Recovery Plan minimum recommendations of 30 percent. In the ponderosa pine-oak cover type in protected activity centers, trees 12 to 18 inches in diameter at breast height would increase from 27 percent in the existing condition to 30 percent after 20 years after implementation which meets Mexican spotted owl Recovery Plan minimum recommendations of 30 percent. In the mixed conifer cover type, trees greater than 18 inches in diameter at breast height would increase from 33 percent in the existing condition to 48 percent of the trees in protected activity centers after 20 years after implementation. In the ponderosa-pine oak cover type, trees greater than 18 inches in diameter at breast height would increase from 25 percent of total trees in the existing condition to 37 percent total of trees in the protected activity center after 20 years after implementation.

Treatment in protected activity centers would be consistent with recovery plan management recommendations and desired conditions which include a diversity of trees with the goal of having trees greater than 16 inches diameter at breast height contributing more than 50 percent of the stand basal area (Table C.2 from the Revised Mexican spotted owl Recovery Plan, 2012). In the mixed conifer cover type, trees greater than 18 inches diameter at breast height would represent 48 percent of all trees in the protected activity center 20 years after implementation. In the ponderosa pine-oak cover type, trees greater than 18 inches diameter at breast height would represent 37 percent of all trees in the protected activity center. Combined with the 12- to 18-inch age class, (30 percent of trees in the protected activity center in this size class) it is likely that trees greater than 16 inches diameter at breast height would make up 50 percent or more of all trees in the protected activity center. This would provide for all life history needs (nesting, roosting, foraging) by emphasizing large trees, and should provide for large snags and logs (Ganey et al. 2003).

Alternative 2 Mexican Spotted Owl Nest/Roost Recovery Habitat

All treatments in nest/roost recovery habitat would follow Mexican spotted owl recovery habitat recommendations from Table C.2 of the Revised Mexican spotted owl Recovery Plan (2012). Treatments would maintain or increase most habitat variables important to the Mexican spotted owl while ultimately conserving these conditions over time. Preserving Mexican spotted owl habitat by using thinning and prescribed burning treatments, while promoting large trees and reducing risk of fire hazard index and

crown fire, is one of the main objectives of the Rim Country Project (returning resiliency to the forested ecosystem).

Trees per acre in nest roost recovery habitat were modeled to show effects from implementation over 20 years. In the mixed conifer cover type, results show that the number of trees greater than 18 inches diameter at breast height would increase from 24 trees per acre in the existing condition to 26 trees per acre after 20 years of implementation. In the ponderosa pine-oak cover type, results show that the number of trees greater than 18 inches diameter at breast height would increase from 20 trees per acre in the existing condition to 23 trees per acre after 20 years of implementation. For acres analyzed using the forest vegetation simulator geophysical model, results show that the number of trees greater than 18 inches diameter at breast height would increase from 18 trees per acre in the existing condition to 20 trees per acre after 20 years of implementation. These results show that the number of trees greater than 18 inches diameter at breast height per acre would exceed minimum Recovery Plan recommendations of 12 per acre in nest/roost recovery habitat 20 years after implementation.

The overall effect of treatments in nest/roost recovery habitat, 20 years of implementation, would be to increase large trees. Models indicate that the proportion of trees greater than 18 inches diameter at breast height would be well above minimum recovery plan recommendations in all cover types. In the mixed conifer cover type, the proportion of trees greater than 18 inches diameter at breast height would increase from 42 percent of total trees in the existing condition to 63 percent of all trees after 20 years of treatment. In the ponderosa pine-oak cover type, the proportion of trees greater than 18 inches diameter at breast height would increase from 36 percent of all trees to 53 percent. For the areas identified as recovery nest/roost habitat by the forest vegetation simulator geophysical model, the proportion of trees greater than 18 inches diameter at breast height would increase from 38 percent under existing conditions to 52 percent of total trees 20 years following implementation. The increases in proportion of trees greater than 18 inches in diameter in nest/roost recovery would provide for all life history needs of Mexican spotted owls (nesting, roosting, foraging) by emphasizing large trees, and should provide for large snags and logs (Ganey et al. 2003).

The proportion of trees in the 12-18-inch diameter size class in the mixed conifer cover type would decrease from 36 percent under existing conditions to 24 percent of all trees 20 years following treatment. In the ponderosa pine-oak cover type, the proportion of trees in the 12- to 18-inch diameter size class would decrease from 33 percent in the existing condition to 25 percent 20 years after treatment. For acres identified as nest/roost recovery habitat using the geophysical model for the Tonto National Forest, the proportion of trees in the 12- to 18-inch diameter size class would decrease from 39 percent in the existing condition to 22 percent of all trees 20 years after implementation. These modeled decreases are likely due, at least in part, to trees growing out of the 12- to 18-inch diameter size class into the greater-than-18-inch diameter size class as described above. Regardless, silvicultural prescriptions in all cover types of nest/roost recovery habitat should seek to increase proportions of trees in this size class whenever possible, while retaining and recruiting trees larger than 18 inches in diameter, to avoid or mitigate decreases evident in the modeling results.

Shrub and herbaceous biomass would also be maintained or increase in alternative 2. Forest vegetation simulator modeling shows risk of crown fire and the fire hazard index (decreasing fuel loading) would be reduced 20 years post implementation, while coarse woody debris, downed logs, and snags greater than 12 inches diameter at breast height (with three snags per acre greater than 18 inches diameter at breast height in mixed conifer and two snags per acre greater than 18 inches diameter at breast height in the ponderosa pine-oak cover type) would increase 20 years after treatment in Mexican spotted owl nest/roost recovery habitat.

Surface fuel loading in Mexican spotted owl nest/roost recovery habitat would be reduced under alternative 2, the Proposed Action, moving from 28 tons per acre in mixed conifer, 18 in ponderosa pine-oak, and 23 geophysical model to 22 tons per acre in mixed conifer, MC and 17 tons per acre in ponderosa pine-oak, P-O and 18 geophysical model (GM) after 20 years post treatment after implementation.

Alternative 2 Mexican Spotted Owl Foraging/Non-breeding Recovery Habitat

Alternative 2 would move this habitat type closer to desired condition for the Mexican spotted owl. In foraging/non-breeding recovery habitat, treatments would maintain or increase most habitat variables beneficial to the Mexican spotted owl, its critical habitat, and its prey species, while conserving these conditions over time. These treatments would preserve foraging/non-breeding recovery habitat by thinning and burning while promoting large trees and reducing the fire hazard index and the risk of crown fire. These estimates indicate that treatments would align with Mexican spotted owl Recovery Plan recommendations.

Trees per acre in foraging/non-breeding recovery habitat were modeled to show effects from implementation after 20 years. Results show that the number of trees greater than 18 inches in diameter in the mixed conifer cover type would increase from 16 trees per acre in the existing condition to 17 trees per acre 20 years after implementation. In the ponderosa pine-oak cover type, results show that the number of trees greater than 18 inches in diameter would increase from 13 trees per acre in the existing condition to 14 trees per acre 20 years after implementation. For areas modeled using the forest vegetation simulator geophysical model, results show that the number of trees greater than 18 inches in diameter would increase from 13 trees per acre in the existing condition to 12 trees per acre 20 years after implementation. Results from both cover types and from the acres analyzed using the geophysical model show that the number of trees with diameters greater than 18 inches would exceed or meet minimum Recovery Plan recommendations of 12 per acre.

According to the modeling, under alternative 2 the proportion of trees greater than 18 inches diameter at breast height would increase from the existing condition in both cover types and on acres identified using the geophysical model. In the mixed conifer cover type, results show that the proportion of trees in the 19- to 24-inch size class (and combined with the largest age class, greater than 24 inches diameter at breast height) would increase from 28 percent of total trees under the existing condition to 40 percent of all trees 20 years following treatment. In the ponderosa pine-oak cover type, the proportion of trees greater than 18 inches diameter at breast height would increase from the existing condition of 22 percent of total trees to 32 percent of total trees after 20 years after implementation. For the acres identified using the geophysical model, the proportion of trees greater than 18 inches diameter at breast height would increase from 24 percent of all trees under the existing condition to 29 percent after 20 years of implementation.

As in nest/roost recovery habitat under alternative 2, the proportions of trees in the 12- to 18-inch diameter size class would decrease from the existing condition in both cover types and on acres identified using the geophysical model 20 years after implementation. And similar to the results for this size class in nest/roost recovery habitat, the modeled decreases are likely due, at least in part, to trees growing out of the 12- to 18-inch diameter size class into the greater-than-18-inch diameter size class as described above. In the mixed conifer cover type the proportion of trees in the 12- to 18-inch diameter size class would decrease from 30 percent of all trees in the existing condition to 17 percent 20 years after implementation. In the ponderosa pine-oak cover type the proportion of trees in the 12- to 18-inch diameter size class would decrease from 28 percent to 15 percent of all trees. For acres identified using the geophysical model, the proportion of trees in the 12- to 18-inch diameter size class would decrease from 30 percent to 13 percent of all trees. Silvicultural prescriptions in all cover types of foraging/non-breeding recovery

habitat should seek to increase proportions of trees in this size class whenever possible, while retaining and recruiting trees larger than 18 inches in diameter, to avoid or mitigate decreases evident in the modeling results.

Shrub and herbaceous biomass would also be maintained or increase in foraging/non-breeding recovery habitat under alternative 2. Forest vegetation simulator modeling shows 20 years of treatments would reduce risk of crown fire and the fire hazard index (decreasing fuel loading), while increasing coarse woody debris, downed logs, and snags greater than 12 inches in diameter (with three snags greater than 18 inches in diameter per acre in mixed conifer and two snags greater than 18 inches in diameter per acre in the ponderosa pine-oak cover type) after 20 years of treatment.

Reductions in surface fuel, creation of interspaces, and uneven-aged management would conserve Mexican spotted owl foraging/non-breeding recovery habitat over time. By providing for large trees, woody debris, snags, shrubs and hardwoods in Mexican spotted owl foraging/non-breeding recovery habitat in the project area, alternative 2 would encourage foraging/non-breeding recovery habitat to develop into nesting and roosting habitat over time. Fuel loads, the fire hazard index, and the risk of crown fire would also be greatly reduced as a result of treatment (see Fire Effects analysis below).

Alternative 2 Fire Effects

Surface Fuel Loading

Surface fuel loading in Mexican spotted owl protected habitat would slightly increase under the proposed action, moving from an existing 25 tons per acre in mixed conifer and 19 tons per acre in ponderosa pine-oak to 26 tons per acre in mixed conifer and 19 in ponderosa pine-oak after 20 years of treatment. Timber management will decrease these modeled results by removing the majority of cut material.

Surface fuel loading in Mexican spotted owl nest/roost recovery habitat would be reduced under alternative 2, moving from 28 tons per acre in mixed conifer, 18 tons per acres in ponderosa pine-oak, and 23 tons per acres in the geophysical model to 22 tons per acre in mixed conifer, 17 tons per acre in ponderosa pine-oak, and 18 tons per acre in the geophysical model after 20 years of implementation.

Surface fuel loading in Mexican spotted owl Foraging/Non-breeding Recovery habitat would be reduced under alternative 2, moving from an existing condition of 23 tons per acre in mixed conifer, 16 tons per acre in ponderosa pine-oak, and 18 tons per acre geophysical model to 16 tons per acre in mixed conifer, 12 tons per acre in ponderosa pine-oak, and geophysical model in after 20 years of implementation.

Fire Hazard Index

The moderate, high, and extreme need for treatment categories of fire hazard index are decreased under alternative 2 in protected activity centers from the existing condition of 70,328 acres (62 percent) to 57,583 acres (49 percent) after 20 years. The high and extreme need for treatment categories are reduced from 51,002 acres (45 percent) of all protected activity centers modeled in the existing condition to 31,831 acres (27 percent) after alternative 2 is implemented.

In nest/roost recovery habitat the moderate, high, and extreme need for treatment categories of fire hazard index are decreased under alternative 2 from 22,628 acres (60 percent) from the existing condition to 14,114 acres (37 percent) after 20 years. The high and extreme need for treatment categories are reduced from 15,869 acres (42 percent) of all nest/roost recovery habitat modeled in the existing condition to 6,780 acres (18 percent) after alternative 2 is implemented.

In foraging/non-breeding Mexican spotted owl recovery habitat the moderate, high, and extreme need for treatment categories of fire hazard index are decreased from 84,363 acres (46 percent) in the existing condition to 42,304 acres (23 percent) after alternative 2 is implemented. The high and extreme need for

treatment categories are reduced from 51,210 acres (28 percent) of all foraging/non-breeding recovery habitat modeled in the existing condition to 11,710 acres (6.4 percent) after alternative 2 is implemented.

Risk of Crown Fire

In protected activity centers, the potential for active and conditional crown fire is decreased in alternative 2 compared to the existing condition from 58,765 acres (51 percent) to 38,818 acres (34 percent).

Reducing the potential for high-severity crown fire in Mexican spotted owl habitat, would benefit the species. Active crown fire risk is reduced from 39 percent of all protected activity center habitat in the project area to 28 percent after 20 years.

In nest/roost recovery habitat the potential for active and conditional crown fire is decreased in alternative 2 compared to the existing condition from 18,275 acres (48 percent) to 7,776 acres (21 percent) after implementing alternative 2. Reducing active and conditional crown fires by this magnitude is a benefit to the Mexican spotted owl that would preserve nest/roost recovery habitat over time. Active crown fire risk is reduced from 39 percent of all nest/roost recovery habitat in the project area to 14 percent after 20 years.

In foraging/non-breeding recovery habitat the potential for active and conditional crown fire is decreased in alternative 2 compared to the existing condition from 63,737 acres (34 percent) to 15,306 acres (8 percent) after implementation. Reducing active and conditional crown fires by this magnitude is a benefit to the Mexican spotted owl and would preserve foraging/non-breeding recovery habitat over time. Active crown fire risk is reduced from 27 percent of all nest/roost recovery habitat in the project area to 6 percent after 20 years.

Alternative 2 Effects from Implementation Activities

The Rim Country Project proposes treatments in all Mexican spotted owl habitat types. While design features have been included to minimize disturbance affects to the species, it is possible that individual owls could be disturbed by thinning and burning operations. The effects of the proposed thinning are anticipated to result in direct effects to the owl as discussed below. During implementation, protected activity centers would be avoided during the breeding season unless the protected activity center is surveyed to protocol and determined to be unoccupied with concurrence from the USFWS per design features.

Activity - Mechanical Removal of Vegetation; Noise

Heavy machinery used to thin, pile, grind, and remove vegetation in Mexican spotted owl habitat could directly disturb individual owls through noise. Adult and juvenile owls could experience harassment if Mexican spotted owl remain in the area during the winter/non-breeding season. Literature examining noise disturbance in regard to Mexican spotted owl is extensively reviewed in the 1st 4FRI EIS wildlife specialist report in the Mexican spotted owl analysis. In Rim Country, noise disturbance from project activities may affect foraging Mexican spotted owl, but are not expected to affect nesting or roosting owls due to design features. Design features to protect nesting or roosting owls include restricting implementation to outside of the breeding season, 1/4 mile buffers from the protected activity center boundary, and coordination with USFWS in project planning. Numerous design features have been added to minimize disturbance to the Mexican spotted owl from implementation (appendix C of the FEIS). Effects to individual owls from noise disturbance would be a reduction in fitness (Tempel and R.J. Gutiérrez 2003, Damiani et al. Undated). Seasonal nest/roost restrictions should avoid effects to nesting/roosting Mexican spotted owl, however individuals that overwinter in the protected activity center could still be disturbed through noise.

Activity - Upland Mechanical Removal of Vegetation; Habitat Alteration

No mechanical treatment would occur in Mexican spotted owl core areas. Heavy machinery used during implementation would have direct and indirect effects to Mexican spotted owl through habitat alteration would affect 11,225 acres in protected activity centers (see terrestrial wildlife specialist report), 23,813 acres in nest/roost recovery habitat, and 130,271 acres of foraging/non-breeding recovery habitat. Habitat alteration would have short term negative impacts to plant cover, but long term beneficial effects to plant cover through improvement of habitat resilience, structure, and function. Removal of small, encroached trees and decreasing fuel load could result in short term (1 to 2 years) negative effects to Mexican spotted owl habitat with long term beneficial effects as silvicultural prescriptions would reduce fuel loading and increase habitat variables important to the Mexican spotted owl (see Fire Effects and Vegetation Changes sections above). Removing heavily encroached areas (or areas with high small diameter tree density) of Mexican spotted owl habitat would reduce risk of high-severity wildfire and promote large trees and snags, shrub and herbaceous vegetation, with small openings created (0.5 to 2 acres). Short-term affects to Mexican spotted owl habitat are expected to occur as a result of restoration thinning activities (1 to 2 years after treatment) with long-term benefits occurring as vegetation responds to prescribed treatments. Forest structure and habitat for prey base (forest vegetation simulator modeling) are extensively analyzed above, by Mexican spotted owl habitat type under alternative 2, discussing these long-term improvements. Short term affects are considered to be minimized by design features; however, it is possible that individual Mexican spotted owl could be disturbed either directly or indirectly from these activities due to the large spatial and temporal size of the Rim Country Project.

Included in the 11,225 acres of mechanical removal of vegetation, 130 acres are proposed for severe disturbance area treatments in Mexican spotted owl Protected habitat (see terrestrial wildlife specialist report for additional information). Mechanical equipment would be used to reduce over encroached, small diameter trees, mostly under 12 inches diameter at breast height. Approximately 248 acres of severe disturbance area treatments are proposed in Mexican spotted owl nest/roost recovery habitat.

In protected activity centers in the Rim Country project area, 140 acres of mechanical removal of vegetation is proposed (see the terrestrial wildlife specialist report for additional information). Approximately 5,302 acres of facilitative operations using mechanical equipment is proposed in Mexican spotted owl recovery habitat.

Facilitative operations and severe disturbance area treatments using heavy mechanical equipment could directly affect Mexican spotted owls through noise disturbance, and both directly and indirectly from habitat alteration. This could affect individual non-breeding owls. The acreage proposed for treatment with facilitative operations and severe disturbance acre treatment are minimal, and long-term benefits include the preservation of Mexican spotted owl habitat.

Under alternative 2, there would be indirect effects from the modification of vegetation. Burning, thinning, and the associated ground disturbance could adversely affect the prey base on a short-term basis by impacting individuals of prey species due to disturbance of prey species' habitat and harm from fire. However, over the long-term, an increased diversity of vegetative structural stages and improved understory vegetation with improved plant species richness would increase prey species, resulting in indirect beneficial impacts (see forest vegetation simulator modeling above).

Activity - Mechanical Removal of Vegetation; Hauling

Hauling on existing roads, and skid trails is another activity that would potentially effect owls. In the short-term, road work and particularly hauling materials off forest increases the risk of collisions between Mexican spotted owls and vehicles involved in forest harvest activities. There are documented mortalities of Mexican spotted owls from collisions with moving vehicles (Delaney, and Grubb 2003), including

unpaved forest roads (USDI 2012). Little information is available on how frequently collisions might occur and what conditions might relate to owls being more or less vulnerable. Birds migrating or dispersing through unfamiliar terrain may be at higher risk than resident birds (USDI 2012). While collisions are not typically analyzed in vegetation manipulation projects, we felt the scale of the Rim Country project area in terms of time, area, and intensity of road traffic warranted this consideration.

Haul routes may cause noise disturbance to nesting owls and logging trucks could potentially hit owls, causing injury or death. Most logging traffic would occur during daytime hours when owls are not as mobile; however there could be occasions when trucks are operating at times when owls would be foraging in the area during the late afternoon or early morning. As owls can be active during crepuscular hours and could, on occasion, forage during daylight, which increases the risk of noise disturbance from road activities to individual foraging Mexican spotted owls. In addition, hauling of forest materials is also likely to occur at night. Disturbance to foraging owls would be site-specific and could cause owls to shift to areas that provide undisturbed foraging opportunities.

Design features would restrict breeding season hauling within 0.25 mile of the protected activity center boundaries. Timing restrictions may also be waived if the district biologist, in coordination with USFWS determines actions within 0.25 mile will not disturb nesting birds. Task orders would be issued to implement work in defined portions of the Rim Country project area on a yearly basis. Work would be spread across the treatment area and implementation would occur in an incremental manner as new annual task orders are issued. Vehicular activities resulting from harvest operations would increase current traffic levels well above existing conditions in portions of the treatment area on an annual basis for the duration of the project. This would typically create an increase in risk of collisions in localized areas for about 2 to 4 years before operations would shift to other areas. The level of short-term risk cannot be quantified, that is, there is no defined relationship between open road miles or vehicle use and collisions with owls. Nevertheless, whatever the current risk level is, it would likely increase with implementation of the Rim Country Project. This localized, short-term risk would continue to move around the landscape for the duration of Rim Country Project-related harvest activities, although not all harvest and related actions would overlap with Mexican spotted owl habitat. Once harvest activities are complete, roads would be decommissioned, decreasing the risk of collisions across the implementation area over the long term.

Activity - Upland Mechanical Removal of Vegetation; Skid Trails, Road Maintenance, and Temporary Road Construction

Road maintenance and construction would have short-term negative effects to habitat from up to 330 miles of new temporary or existing non-system roads project wide. Some increased sediment movement is expected to occur as a result, though design features would minimize these effects. Temporary roads would be decommissioned after restoration activities are completed. No temporary roads or cable yarding in protected activity centers are proposed, therefore effects from these activities in protected activity centers are not analyzed.

Long-term beneficial effects are expected from the decommissioning of 490 miles of existing roads and up to 800 miles of unauthorized roads in the project area. No road decommissioning activities would occur during the breeding season in protected activity centers.

Owls can be active during crepuscular hours and could, on occasion, forage during daylight, increasing the risk of noise disturbance from road or skid trail activities to individual foraging Mexican spotted owls. Disturbance to foraging owls would be site-specific and could cause owls to shift to areas that provide undisturbed foraging opportunities. There could be energetic costs and increased risk of predation associated with displacement of foraging owls.

Transportation-related activities have timing and ¼ mile distance restrictions in or near protected activity centers and core areas. With design features all mechanized equipment would avoid in core areas and avoid working in protected activity centers with a 0.25-mile buffer during the nesting season. Hauling would require trucks to drive the posted speed limit on all forest system roads. During implementation, noise disturbance to nesting and roosting owls as a result of preplanning, project design features, and mitigation would be avoided with design features. It is not unreasonable to anticipate unforeseen circumstances leading to a need to conduct road work or hauling within a protected activity center during the breeding season. Timing restrictions may be waived if protocol surveys indicate non-breeding or infer absence. Timing restrictions may also be waived if the district biologist, in coordination with USFWS determines actions within 0.25 mile will not disturb breeding birds.

Activity - Upland Hand Thinning

Hand thinning of small diameter fuels on 1,190 acres in protected activity centers would occur where needed as determined by fire and fuels specialists. Hand thinning would occur to facilitate prescribed fire in order to keep fire effects to low severity ground fire in protected activity centers. Hand thinning would modify fire behavior, not stand structure. Direct effects from fire crews or contracted crews disturbing nonbreeding Mexican spotted owl are possible. The total acreage of habitat alteration from low severity prescribed fire would be minimal. Design features would minimize or eliminate disturbance effects to breeding or juvenile Mexican spotted owls as because of seasonal restrictions. Hand thinning and subsequent prescribed fire activities would only occur if surveys confirm that the owls are non-nesting, or a protected activity center is 0.25 mile away and it is determined the pair would not be disturbed. Overwintering Mexican spotted owl who remain in the protected activity center area could be disturbed by these activities in the short-term, though this is not likely to cause reduction in foraging or fitness.

Activity - Prescribed Burning of Vegetation; Habitat Alteration

There are 80,898 acres of protected activity centers in the Rim Country project area that could be burned using prescribed fire over the life of the project. All of these acres would have prescribed fire after thinning treatments.

Where there are no roads, trails, or natural barriers, new fire line could be built to protect resources to facilitate prescribed fire. Building fire line would occur outside the breeding season. No fire line would be built in core areas. Potential effects of fire line construction include effects to habitat such as erosion or loss of cover for prey species. Fireline “trails” (social trails) could increase recreation and access in protected activity centers, increasing disturbance and potential loss of snags and logs. Firelines in protected activity centers would be rehabilitated where resource specialists determine it would benefit the Mexican spotted owl and Mexican spotted owl habitat.

Under alternative 2, there would be indirect effects from the modification of vegetation from prescribed fire. During broadcast burning activities, torching may occur within treatment areas. Torching is expected to create small openings of less than an acre in size, however a change in the stand structure from this type of event would not be detectable on a stand basis. Torching would mimic gap processes that occur under natural conditions (historic wildfire, windfall, and historic pest and disease outbreaks). Broadcast burning would decrease coarse woody debris in all protected and recovery habitat treatments; however, levels would range from 3 to 10 tons per acre in ponderosa pine-oak habitat and 5 to 15 tons per acre in mixed conifer which would meet land management plan requirements. Woody debris and snags are habitat for small mammals. Indirect effects of reducing woody debris from broadcast burning would decrease prey base abundance on a short-term basis for approximately one year (Jenness 2000). This decrease in small mammal prey base could be compounded during drought years when the prey base is lower due to a lack of food for these animals. However, herbaceous vegetation typically responds

favorably to broadcast burning, and an increase in forage for small mammals is expected, outside of drought conditions. This in turn would have a corresponding increase in the small mammal prey base (Jenness 2000).

In conjunction with prescribed burning across the project area, whenever possible, prescribed burning would be applied to the entire protected activity center area, including the core. When this approach is feasible, the Forest Service would not separate prescribed burning of protected activity centers from the surrounding project area. This strategy minimizes disturbance from fire containment actions (handline construction as existing roads could be used as fireline) and the prescribed fire operations that would be needed to safely burn through Mexican spotted owl habitat. This also provides flexibility for fire managers to minimize burn severity (such as backing fire down slope) within core areas.

Prescribed burning would result in short term alteration of habitat through fire effects though these will likely be minimal across most of the project area. Direct effects from prescribed burning could be noise disturbance or harassment of non-breeding owls from fire crews. Indirect effects are changes in small acres of nesting and roosting habitat from fire effects. Individual owls over wintering in protected activity centers could be affected by mid-story vegetation changes, though these would be in the short term from prescribed fire, likely 1-2 years. This could result in short term reduced feeding success and fitness of individual Mexican spotted owls, with long term benefits of protecting the protected activity center from severe wildfire while promoting habitat variables important to the Mexican spotted owl.

Activity - Prescribed Burning of Vegetation: Smoke

There are 80,898 acres of protected activity centers in the Rim Country project area that could be burned using prescribed fire over the life of the project. Fire experts on the three National Forests associated with Rim Country indicated smoke associated with prescribed fire typically does not settle into low-lying areas for more than 2 or 3 nights. Limited smoke within protected activity centers represents an aspect of the evolutionary environment for wildlife in northern Arizona and, as such, should result in negligible effects to Mexican spotted owl (Horton and Mannan 1988). However, first-entry burns would include fuel loads above historical levels, causing quantities of smoke greater than what would likely have occurred during frequent fire return intervals. As a result, uncharacteristically dense smoke could settle into protected activity centers during initial burn operations. Dense smoke from first-entry burns (areas that have not burned in 20 or more years) settling into core areas early in the season (March through June) could affect brooding females. This is unlikely to occur because of the design features: seasonal restrictions to limit prescribed burning and thinning in protected activity centers to outside of the breeding season and the ¼ mile buffer to restrict noise from protected activity centers and core areas during the breeding season.

Despite the possibilities discussed above, smoke is not expected to be a disturbance to MSOs for several reasons as detailed here. Settling smoke has long been an issue that fire experts address on this landscape. This has led to knowledge of smoke patterns and developing ignition techniques to minimize undesirable smoke effects. In addition, smoke from prescribed fire would comply with Arizona Department of Environmental Quality requirements (ADEQ). Smoke effects are regulated and permits are required by ADEQ before burning is initiated. Air quality requirements specify management actions would meet air quality standards. ADEQ considers the cumulative effects of smoke emissions from multiple jurisdictions prior to approving daily prescribed fire activities. This mitigates the potential for severe smoke effects from multiple prescribed fire projects across the treatment area. Given the planning, design features, and ignition techniques, smoke from prescribed fire would not be expected to result in adverse effects to Mexican spotted owl. However, this cannot be guaranteed and adverse effects to owls could occur if smoke unexpectedly settled into protected activity centers for three or more days and nights.

Smoke could result in decreased air quality to individual Mexican spotted owls who overwinter in the protected activity centers. This disturbance would affect non-breeding individual Mexican spotted owl disturbed if smoke settles. This is minimized by seasonal restrictions on burning in protected activity centers and careful planning from district fire and fuels specialists so smoke would not settle in protected activity centers during the breeding season. If surveys show absence or non-nesting in specific protected activity centers flexibility to burn during the breeding season given these specific survey results could occur in coordination with USFWS.

Activity - Comprehensive Habitat Restoration: Heavy Mechanical Equipment

Mechanical thinning is also proposed as part of grassland, wet meadow, and riparian restoration (comprehensive restoration) to remove conifer encroachment and meet desired conditions. In addition, mechanical equipment may be utilized for stream and spring restoration. There are up to 2,099 acres of mechanical thinning proposed for comprehensive restoration in protected activity centers and 4,981 acres of recovery habitat (1,636 acres in nest/roost recovery habitat and 3,345 in foraging/non-breeding recovery habitat) proposed for mechanical thinning for comprehensive restoration. Protected activity center timing restriction design features would also apply to comprehensive restoration activities. Therefore, implementation would occur outside of the breeding season or timing restrictions may be waived if protocol surveys indicate non-breeding or infer absence. Timing restrictions may also be waived if the district biologist, in coordination with USFWS determines actions within 0.25 mile will not disturb nesting birds. Therefore, design features would minimize disturbance effects to the Mexican spotted owl from comprehensive habitat restoration implementation in protected activity centers.

Wildlife Design Features that reduce effects to the Mexican spotted owl and its habitat from mechanical thinning activities which include managing for Basal Area (WL001-002), coordinating management to reduce potential disturbance and minimize the frequency and duration of operations within and immediately adjacent to these areas (WL003), and provide seasonal breeding season restrictions (WL005-007). The Appendix D, Large and Old Tree Implementation plans include sideboards that would leave these trees on the landscape. The proposal seeks to remove encroaching small diameter conifer trees with the majority of trees taken below 12" diameter at breast height where applicable in Mexican spotted owl habitat to promote habitat variables that are considered beneficial to the owl (see proposed action).

Up to 148.2 miles of general stream restoration and 23.3 miles of heavy mechanical stream restoration are proposed in protected activity centers with potentially 23.3 miles of general and 4.9 miles of heavy mechanical in core areas. General stream treatments include methods that could either be implemented by hand or using machinery such as driving a vehicle to a site, pneumatic post pounder, or gas-powered auger. Heavy mechanical treatments are those that require machinery such as a trackhoe or front-end loader. Both implementation types could have effects to Mexican spotted owl through noise and habitat alteration, though design features should minimize disturbance to nesting owls (see above). These methods generally occur within the stream channel and floodplains. Projects utilizing heavy machinery are likely to be larger in scope than those using only hand methods. In addition, there is often a temporal difference in the realization of positive effects from the various methods. Though disturbance may be initially higher with heavy machinery, project effects are often less noticeable soon after the project is completed. Projects that use hand methods often take a more natural approach and require several seasons of flow events or vegetation growth to produce measurable improvements to habitats. Hand thinning in protected activity centers would be considered where applicable to reduce effects where these activities would occur, or where access with heavy machinery is not feasible.

Short term effects to the Mexican spotted owl from comprehensive restoration mechanical thinning activities would generally include temporary reduction of riparian vegetation cover in the project area and

change of channel structure. These impacts are considered short-term and the results would benefit riparian habitat by thinning encroached systems which would also benefit the Mexican spotted owl. Design features would reduce disturbances to the owl as breeding owls would not be disturbed. Non-breeding owls that could remain in the area could be disturbed by noise and general implementation activities (presence of machinery), though beneficial impacts of general stream treatments can be immediate and long-term.

Multiple project design features are included in the project to reduce adverse impacts where feasible given the nature of these methods. Reducing heavy equipment impacts are addressed in AQ008, AQ024, AQ032-34, SW060-61, SW073-74, SW076, SW079 to reduce direct impacts and sedimentation. Reducing impacts to riparian vegetation is covered by AQ014, AQ035, AQ037, SI001, SI003, SI023, and SW008-9 while protecting stream shade is included in AQ037-38. There also design features for site rehabilitation (SW065-66) and stockpiling materials from uplands for use in streams (AQ021).

The above activities proposed in Mexican spotted owl habitat for Comprehensive Restoration using heavy mechanical equipment could directly affect owls through noise disturbance, and both directly and indirectly from habitat alteration. This could affect individual non-breeding owls as seasonal restrictions are in place as design features. The Design Features listed above would reduce effects to the Mexican spotted owl and its habitat from implementation activities. Short term negative effects through habitat alteration are largely outweighed by the beneficial long-term effects of comprehensive restoration to restore diverse habitat characteristics to places that have lost them or need restoration.

Alternative 2 Determination of Effects to the Mexican spotted owl

Direct and indirect effects from project actions within protected activity centers and recovery habitat will be short term. Long-term benefits will conserve Mexican spotted owl habitat over time. Effects are summarized below:

- There would be 11,225 acres of vegetation treatments using mechanical equipment in protected 32,813 acres in nest/roost recovery habitat and 130,271 acres of foraging/non-breeding recovery habitat that would have short term negative impacts to plant cover but long term beneficial effects through improvement of habitat resilience, structure, and function. Approximately 1,190 acres is proposed for hand thinning in protected activity centers.
- Approximately 2,192 acres in protected activity centers and 4,991 acres of Mexican spotted owl recovery habitat (1,636 nest/roost recovery habitat and 3,355 foraging/non-breeding recovery habitat) are proposed for comprehensive restoration. Breeding season restrictions in protected activity centers and ¼ mile buffers from protected activity centers for heavy mechanical equipment operation will minimize effects to breeding owls. Foraging owls or individuals who do not leave the protected activity center during the winter could be disturbed during restoration activities. These short-term disturbances are outweighed by long term benefits of conserving Mexican spotted owl habitat.
- Noise associated with thinning and prescribed burning activities could disturb non-breeding Mexican spotted owls that remain in the area during the breeding season.
- Hauling would not occur within 0.25 mile of protected activity centers and nest cores. If hauling is needed during the breeding season within or adjacent (within ¼ mile) to protected activity centers, the Forest Service will work with the USFWS to minimize the effects to individuals.
- Fire hazard index and risk of crown fire would be reduced in Mexican spotted owl habitats reducing the potential loss of habitat to wildfire.

- Approximately, 80,898 acres of prescribed burning in protected activity center habitat would be coordinated with the district biologists and would be designed to limit smoke during the breeding season. Pile burning would be completed in the winter and initial entry prescribed burning would be completed in the fall/winter within protected activity centers.
- By managing for resistant and resilient ecosystems, promoting landscape connectivity, and implementing concepts of adaptive management, land and resource management can respond to new information and changing conditions related to climate change that have the potential to increase ecosystem risks. Risks associated with dense forest conditions would be reduced and forest resiliency large scale disturbance under drier and warmer conditions would be improved by implementing the treatments proposed under alternative 2. Individual tree growth would improve, resulting in larger average tree sizes. Species requiring habitat elements associated with closed canopy forest conditions or old or large tree, snag, and log structure would be more sustainable as forest resiliency is improved.

Based on the above analysis the project's activities under alternative 2 of the Rim Country Project may affect, is likely to adversely affect the Mexican spotted owl.

Alternative 3 – Focused Alternative

Alternative 3 Mexican spotted owl Protected Habitat

In protected activity centers after 20 years of implementation, average basal area is reduced for both mixed conifer and ponderosa pine-oak cover types. In mixed conifer, average basal area of trees diameter at breast height decreases from 158 square feet to 133 square feet after 20 years of treatments in protected activity centers. Ponderosa pine-oak average basal area is reduced from 144 square feet in the existing condition to 111 square feet. Silvicultural prescriptions would promote growth of large trees and managers should seek to maintain basal areas above the minimum recovery plan recommendations or seek to increase basal area averages. Trees per acre were modeled in protected activity center habitat to show effects from implementation over 20 years. Results show that the number of trees per acre greater than 18 inches in diameter at breast height in the mixed conifer cover type would increase from 18 trees per acre in the existing condition to 21 trees per acre after 20 years of implementation. Results show that in ponderosa pine-oak cover type, the number of trees greater than 18 inches in diameter at breast height per acre increases trees would increase from 14 trees per acre in the existing condition to 16 trees per acre after two decades of implementation. Results indicate that both cover types would exceed minimum Recovery Plan recommendations of 12 trees greater than 18 inches in diameter at breast height per acre (Table C3 from the Revised Mexican spotted owl Recovery Plan, 2012). A linear regression from basal area was used to estimate canopy cover (Shephard et al. in Parker et al. 2002). These estimates indicate that treatments would align with Mexican spotted owl recovery plan recommendations (Table C3 from the Revised Mexican spotted owl Recovery Plan, 2012) in mixed conifer with canopy cover of 64 percent, and in ponderosa pine oak at 61 percent canopy cover from treatments proposed in alternative 3.

Shrub and herbaceous biomass would also be maintained or increase in alternative 3. Forest vegetation simulator modeling shows 20 years of implementation risk of crown fire and the fire hazard index would be reduced, while coarse woody debris, downed logs, and snags greater than 12 inches in diameter (with 3 snags greater than 18 inches in diameter in mixed conifer and 1-2 snags per acre greater than 18 inches in ponderosa pine-oak cover type) would be increased in Mexican spotted owl protected habitat.

In mixed conifer 20 years of implementation trees 12 to 18 inches in diameter at breast height would decrease by 1 percent, from 29 percent in the existing condition to 28 percent, which stays near Mexican spotted owl recovery plan minimum recommendations of 30 percent. In the ponderosa pine-oak cover type in protected activity centers trees 12 to 18 inches in diameter at breast height increase from

27 percent in the existing condition to 30 percent after 20 years of treatment from alternative 3 which meets Mexican spotted owl recovery plan minimum recommendations of 30 percent.

In the mixed conifer cover type, trees greater than 18 inches in diameter at breast height would increase from 33 percent in the existing condition to 46 percent of the trees in protected activity centers after 20 years after implementation. In the ponderosa-pine oak cover type, trees greater than 18 inches in diameter at breast height would increase from 25 percent of total trees in the existing condition to 35 percent total of trees in the protected activity center after 20 years after implementation.

Treatment in protected activity centers would be consistent with recovery plan management recommendations and desired conditions which include a diversity of trees with the goal of having trees greater than 16 inches diameter at breast height contributing more than 50 percent of the stand basal area (Table C.2 from the Revised Mexican spotted owl Recovery Plan, 2012). In the mixed conifer cover type, trees greater than 18 inches diameter at breast height would represent 48 percent of all trees in the protected activity center 20 years after implementation. In the ponderosa pine-oak cover type, trees greater than 18 inches diameter at breast height would represent 37 percent of all trees in the protected activity center. Combined with the 12- to 18-inch age class, (30 percent of trees in the protected activity center in this size class) it is likely that trees greater than 16 inches diameter at breast height would make up 50 percent or more of all trees in the protected activity center. This would provide for all life history needs (nesting, roosting, foraging) by emphasizing large trees, and should provide for large snags and logs (Ganey et al. 2003).

Alternative 3 Mexican spotted owl Nest/Roost Recovery Habitat

Recovery habitat is proposed for fewer acres than in alternative 2 but would still see various treatment types. In Mexican spotted owl nest/roost recovery habitat, the treatments would maintain or increase most habitat variables important to the Mexican spotted owl while treating and ultimately conserving these conditions over time.

Trees per acre in nest roost recovery habitat were modeled to show effects from implementation over 20 years. In the mixed conifer cover type, results show that the number of trees greater than 18 inches diameter at breast height would increase from 24 trees per acre in the existing condition to 26 trees per acre after 20 years of implementation. In the ponderosa pine-oak cover type, results show that the number of trees greater than 18 inches diameter at breast height would increase from 20 trees per acre in the existing condition to 24 trees per acre after 20 years of implementation. For acres analyzed using the forest vegetation simulator geophysical model, results show that the number of trees greater than 18 inches diameter at breast height would increase from 18 trees per acre in the existing condition to 20 trees per acre after 20 years of implementation. These results show that the number of trees greater than 18 inches diameter at breast height per acre would exceed minimum Recovery Plan recommendations of 12 per acre in nest/roost recovery habitat 20 years after implementation.

The overall effect of treatments in nest/roost recovery habitat, 20 years of implementation from alternative 3, would be to increase large trees. In the existing condition, trees in 12 to 18 inches diameter at breast height size class in the mixed conifer cover type decrease from 36 percent to 23 percent. In the ponderosa pine-oak cover type trees in the 12- to 18-inch age class decrease from 33 percent in the existing condition to 25 percent. From the acres identified using the geophysical model for the Tonto, trees 12 to 18 inches diameter at breast height decrease from 39 percent in the existing condition to 22 percent after 20 years of treatment from alternative 3. Silvicultural prescriptions in all Mexican spotted owl cover types should seek to increase this age class, contradicting these negative model results whenever possible. While this size class is reduced in the modeling the data indicates that trees greater than 18 inches diameter at breast height are well above minimum recovery plan recommendations in all

cover types. In the mixed conifer cover type trees greater than 18 inches diameter at breast height go from 42 percent total trees in nest/roost recovery habitat in this size class in the existing condition to 58 percent of all trees of these age classes in this cover type after 20 years of implementation. In the ponderosa pine-oak cover type trees greater than 18 inches diameter at breast height increase from 36 percent total of trees in nest/roost recovery habitat in this age class to 50 percent. From the acres identified by using the geophysical model forest vegetation simulator, results for trees greater than 18 inches diameter at breast height increase from 38 percent to 52 percent 20 years of implementation.

All treatments in nest/roost recovery habitat will follow Mexican spotted owl recovery habitat recommendations for a diversity of trees with the goal of having trees greater than 16 inches diameter at breast height contributing greater than 50 percent of the stand basal area (Table C.2) from the Revised Mexican spotted owl Recovery Plan (2012). For each cover type; mixed conifer; ponderosa pine-oak. and from acres identified using the geophysical model (other forest cover type/canyon habitat) trees greater than 18" diameter at breast height represent greater than or equal to 50 percent. This will provide for all life history needs (nesting, roosting, foraging) by emphasizing large trees, and should provide for large snags and logs (Ganey et al. 2003).

Preserving Mexican spotted owl habitat by using thinning and prescribed burning treatments, while promoting large trees and reducing risk of fire hazard index and crown fire, is one of the main objectives of the action alternatives in Rim Country (returning resiliency to the forested ecosystem).

Surface fuel loading in Mexican spotted owl nest/roost recovery habitat would be reduced under alternative 3, moving from 28 tons per acre in mixed conifer, 18 in ponderosa pine-oak, and 23 geophysical model to 23 tons per acre in mixed conifer and 19 tons per acre in ponderosa pine-oak and 18 (geophysical model) after 20 years of implementation.

Shrub and herbaceous biomass would also be maintained or increase in alternative 3. Fire modeling shows 20 years of implementation will reduce risk of crown fire and the fire hazard index (decreasing fuel loading), while increasing coarse woody debris, downed logs, and snags greater than 18 inches diameter at breast height (with 3 snags greater than 18 inches diameter at breast height in mixed conifer and 2 snags per acre greater than 18 inches diameter at breast height in ponderosa pine oak cover type) after 20 years of implementation in Mexican spotted owl nest/roost recovery habitat.

Alternative 3 Mexican Spotted Owl Foraging/Non-breeding Recovery Habitat

Treatments proposed under alternative 3 would maintain or increase most habitat variables beneficial to the Mexican spotted owl, its critical habitat, and its prey species, while conserving these conditions over time in foraging/non-breeding recovery habitat. These treatments would preserve foraging/non-breeding recovery habitat by thinning and burning while promoting large trees and reducing the fire hazard index and the risk of crown fire. These estimates indicate that treatments would align with Mexican spotted owl Recovery Plan recommendations.

Trees per acre in foraging/non-breeding recovery habitat were modeled to show effects from implementation after 20 years. Results show that the number of trees greater than 18 inches in diameter in the mixed conifer cover type would increase from 18 trees per acre in the existing condition to 17 trees per acre 20 years after implementation. In the ponderosa pine-oak cover type, results show that the number of trees greater than 18 inches in diameter would increase from 13 trees per acre in the existing condition to 14 trees per acre 20 years after implementation. For areas modeled using the forest vegetation simulator geophysical model, results show that the number of trees greater than 18 inches in diameter would increase from 13 trees per acre in the existing condition to 12 trees per acre 20 years after implementation. Results from both cover types and from the acres analyzed using the geophysical model show that the number of trees with diameters greater than 18 inches would exceed or meet minimum

Shrub and herbaceous biomass would also be maintained or increase in the Proposed Action. Forest vegetation simulator modeling shows 20 years of treatments will reduce risk of crown fire and the fire hazard index (decreasing fuel loading), while increasing coarse woody debris, downed logs, and snags greater than 12 inches (with 3 snags greater 18 inches in mixed conifer and 2 snags per acre greater than 18 inches in Pine oak cover type) after 20 years of treatment in Mexican spotted owl foraging/non-breeding recovery habitat. Reductions in surface fuel and creation of interspaces and uneven aged management would conserve Mexican spotted owl foraging/non-breeding recovery habitat over time. Fuel loads, the fire hazard index, and the risk of crown fire would be greatly reduced as a result of treatment from alternative 3 (see Fire Effects below).

According to the modeling, trees in size 12 to 18 inches diameter at breast height decrease from the existing condition in both cover types and from acres identified by using the geophysical model 20 years of implementation. In mixed conifer cover type trees 12 to 18 inches diameter at breast height decrease from 30 percent in the existing condition to 19 percent, 20 years of implementation from alternative 3. In ponderosa pine-oak trees 12 to 18 inches diameter at breast height decrease from 28 percent to 22 percent of trees in this size class. In acres identified by using the geophysical model trees 12 to 18 inches diameter at breast height decrease from 30 percent to 16 percent of all trees in foraging/non-breeding recovery habitat of this size class. Silvicultural prescriptions in all cover types of foraging/non-breeding recovery habitat should seek increase this size class to contradict the model results.

In the mixed conifer cover type, large trees in the 19 to 24 inches age class in mixed conifer cover type (and combined with largest age class greater than 24 inches diameter at breast height) would increase from the existing condition 28 percent total of trees greater than 18 inches diameter at breast height. Trees 19 to 24 inches and greater in mixed conifer cover type will represent 40 percent total of all trees in these size classes in foraging/dispersal recovery habitat after 20 years of implementation. In the ponderosa pine-oak cover type, the proportion of trees greater than 18 inches diameter at breast height would increase from the existing condition of 22 percent of total trees to 32 percent of total trees after 20 years after implementation. For the acres identified using the geophysical model, the proportion of trees greater than 18 inches diameter at breast height would increase from 24 percent of all trees under the existing condition to 29 percent after 20 years of implementation. Alternative 3 moves this habitat type closer to desired condition for the Mexican spotted owl. Trees greater than 18 inches diameter at breast height increase as compared to alternative 2 in both cover types and on acres identified by using the geophysical model. By providing for large trees, woody debris, snags, shrubs and hardwoods the Mexican spotted owl foraging/non-breeding recovery habitat in the project area will develop into nesting and roosting habitat over time.

Alternative 3 Fire Effects

Surface Fuel Loading

Surface fuel loading in Mexican spotted owl protected habitat would slightly increase under alternative 3, remaining at 26 tons per acre in mixed conifer and 20 in ponderosa pine-oak after 20 years of treatment. Timber management will decrease these modeled results by removing the majority of cut material.

Surface fuel loading in Mexican spotted owl nest/roost recovery habitat would be reduced under alternative 3, moving from 28 tons per acre in mixed conifer, 18 in ponderosa pine-oak, and 23 geophysical model to 23 tons per acre in mixed conifer and 19 tons per acre in ponderosa pine-oak and 18 geophysical model after 20 years of treatment.

Surface fuel loading in Mexican spotted owl foraging/non-breeding recovery habitat would be reduced under alternative 3, moving from an existing condition of 23 tons per acre in mixed conifer, 16 tons per acre in ponderosa pine-oak, and 18 tons per acre geophysical model to 18 tons per acre in mixed conifer,

and 15 tons per acre in ponderosa pine-oak and 13 tons per acre in geophysical model after 20 years of treatment.

Fire Hazard Index

The potential for wildfire activity that would result in more severe effects on ecosystem components than that which should occur in a natural fire regime is illustrated by this analysis. The fire hazard index would be reduced.

The moderate, high, and extreme need for treatment categories of fire hazard index are decreased from alternative 2 in protected activity centers from the existing condition of 70,328 acres (62 percent) to 61,066 acres (52 percent). The high and extreme need for treatment categories are reduced from 51,002 acres (45 percent) of all protected activity centers modeled in the existing condition to 38,268 acres (33 percent) after alternative 3 is implemented.

In nest/roost recovery habitat the moderate, high, and extreme need for treatment categories of fire hazard index are decreased from alternative 2 from 22,628 acres (60 percent) from the existing condition to 15,270 acres (40 percent) after 20 years. The high and extreme need for treatment categories are reduced from 15,869 acres (42 percent) of all nest/roost recovery habitat modeled in the existing condition to 8,519 acres (22 percent) after alternative 3 is implemented.

In foraging/non-breeding Mexican spotted owl recovery habitat the moderate, high, and extreme need for treatment categories of fire hazard index are decreased from 84,363 acres (46 percent) in the existing condition to 59,025 acres (32 percent) after alternative 3 is implemented. The high and extreme need for treatment categories are reduced from 51,210 acres (28 percent) of all foraging/non-breeding recovery habitat modeled in the existing condition to 27,355 acres (15 percent) after alternative 3 is implemented.

Risk of Crown Fire

The risk of crown fire is reduced under alternative 3, from the existing condition. But not as much as in alternative 2. As with the fire hazard index analysis above, the potential for wildfire activity that would result in more severe effects on ecosystem components than that which should occur in a natural fire regime is illustrated by this analysis. The potential of crown fire would be greatly reduced in the alternative 3.

In protected activity centers, the potential for active and conditional crown fire is decreased in alternative 3 compared to the existing condition from 58,765 acres (51 percent) to 42,986 acres (37 percent). Reducing the potential for of this habitat type in the project area that would experience high-severity crown fire in Mexican spotted owl habitat, would benefit the species. Active crown fire risk is reduced from 39 percent of all protected activity center habitat in the project area to 33 percent after 20 years.

In nest/roost recovery habitat the potential for active and conditional crown fire is decreased in alternative 2 compared to the existing condition from 18,275 acres (48 percent) to 9,829 acres (26 percent) after implementing alternative 3. Active crown fire risk is reduced from 39 percent of all nest/roost recovery habitat in the project area to 23 percent after 20 years.

In foraging/non-breeding recovery habitat the potential for active and conditional crown fire is decreased compared to the existing condition from 63,737 acres (34 percent) to 31,208 acres (17 percent) after implementing alternative 3. Active crown fire risk is reduced from 27 percent of all nest/roost recovery habitat in the project area to 15 percent.

In Mexican spotted owl critical habitat, the potential for active and conditional crown fire is decreased in alternative 3 compared to the existing condition from 242,642 acres (35 percent) to 144,020 acres

(21 percent). Active crown fire risk is reduced from 27 percent of all Mexican spotted owl critical habitat in the project area to 19 percent.

Alternative 3 Effects from Implementation Activities

Alternative 3 would treat fewer acres than alternative 2. The direct and indirect effects would be similar to alternative 2. Alternative 3 includes the same number of miles and acres of comprehensive restoration, while reducing the total number of acres thinned and treated with prescribed burning. In protected activity centers, 24,045 fewer acres would be thinned and treated with prescribed fire. In recovery nest/roost habitat, 7,545 fewer acres would be treated in alternative 3 than alternative 2. In foraging/non-breeding Mexican spotted owl recovery habitat 51,920 545 fewer acres would be treated in alternative 3. Savannah treatments in alternative 3 would be reduced by 15,190 acres from alternative 2, providing less restoration to benefit the Mexican spotted owl prey base. Cable operations in Mexican spotted owl recovery habitat (potential for treatment on 5,907 acres in nest/roost recovery, and 19,168 acres in foraging-non-breeding recovery) would have short-term effects to the understory under the cables, with long-term beneficial effects.

The same analysis for alternative 2 regarding disturbance from implementation activities applies to alternative 3, with less acres treated. While disturbance effects would be lessened slightly with alternative 3, the long-term effects and risk of habitat degradation from stand-altering wildfire or insect infestations would be greater.

Alternative 3 Determination of Effect for the Mexican spotted owl

Based on the above analysis, alternative 3 may affect, is likely to adversely affect the Mexican spotted owl.

Mexican Spotted Owl Critical Habitat

Alternative 1 – No Action

With no management, Mexican spotted owl critical habitat will continue to move away from desired condition. The forest vegetation simulator modeling that cover 20 years, with one thinning and two prescribed burns over the lifetime of the project indicate that while average basal area of mixed conifer and ponderosa pine cover types increases, trees in the intermediate size classes 3 and 4 will encroach forests even more than they do today. This will increase fuel loads beyond desired conditions and the threat of high-severity wildfire is increased (see below).

In Mexican spotted owl critical habitat, the moderate, high, and extreme need for treatment categories of fire hazard index are increased from 288,246 acres (42 percent) in the existing condition to 311,805 acres (45 percent) from alternative 1. The high and extreme need for treatment categories are reduced from 181,505 acres (26 percent) of all Mexican spotted owl critical habitat modeled in the existing condition to 218,159 acres (31 percent) from alternative 1.

In Mexican spotted owl critical habitat, the potential for active and conditional crown fire is increased in alternative 1 compared to the existing condition from 242,642 acres (35 percent) to 257,682 acres (38 percent) after 20 years of no management. Active crown fire risk is increased from 27 percent of all Mexican spotted owl critical habitat in the project area to 35 percent.

Alternative 1 Determination of Effect for Mexican spotted owl critical habitat

Based on the above analysis, alternative 3 may affect, is likely to adversely affect Mexican spotted owl critical habitat.

Alternative 2 – Modified Proposed Action

Under alternative 2, mechanical treatments would occur in portions of all Mexican spotted owl critical habitat except for core areas which would be burned only. Low-severity prescribed fire would be applied to all Mexican spotted owl habitats. No trees greater than 24 inches diameter at breast height would be cut in Mexican spotted owl habitat. Trees up to 18 inches diameter at breast height could be thinned in protected activity centers. Treatments in recovery nest/roost habitat are designed to move forests toward nest/roost conditions. Treatments in nest/roost habitat would not lower forest structure values below the minimum nest/roost levels described in the land management plans and in table C.3 of the Revised Recovery Plan (USDI FWS 2012b). It is assumed that mechanical treatments and two low-severity fires would occur within the project's 20-year timeline.

Mechanical thinning and low-severity prescribed fire would take place at different times in different locations. Mexican spotted owl habitat could be affected by mechanical treatments in one area while prescribed fire occurs in another area in the same period. It is expected implementation of the entire project would require 20 or more years to complete.

Forest Structure

Primary Constituent Elements Related to Forested Structure:

A range of tree species composed of different tree sizes reflecting different ages of trees, 30 – 45 percent of which are large trees (12 inches diameter at breast height or more).

Under alternative 2, forest vegetation simulator modeling from treatments over the next 20 years indicate that most forest structure as it pertains to Primary Constituent Elements important to Mexican spotted owl critical habitat are preserved or increased through time. Forest vegetation simulator modeling indicates trees per acre are reduced from the existing condition because of treatment after 20 years of implementation. Reducing trees per acre closer to natural range of variation protects Mexican spotted owl habitat and restores conditions for the Mexican spotted owl by managing for a less dense, and encroached forested condition. Trees per acre in Mexican spotted owl habitat was shown to maintain or increase trees greater than 18 inches diameter at breast height to greater than 12 per acre, as per the revised Mexican spotted owl Recovery Plan recommendations (see analysis for the Mexican spotted owl above by habitat type). Openings created by bringing these size classes into desired condition would provide habitat for a variety of prey species and would slow or reduce fire severity by breaking the continuity of dense tree canopies and ladder fuels.

The average of all basal areas from tree size classes saplings 1 to old growth 6 show that intermediate sized trees (Size Class 3 with basal area 5 to 12 inches) is predominant on the landscape in the existing condition and vastly departed from the natural range of variation; under alternative 2, the natural range of variation is lowered closer to desired condition as a result of treatment in 20 years. For example, in protected activity centers and in recovery habitat, the average of all trees 12 to 18 inches, 18 to 24 inches, and 24 inches or greater age classes all increase over time as a result of treatment in mixed conifer, ponderosa pine-oak habitat, and Geophysical model. In the existing condition, trees greater than 12" diameter at breast height represent 64 percent of trees in this age class in Mexican spotted owl critical habitat. Forest Vegetation System modeling predicts that after 20 years of treatment, trees greater than or equal to 12 inches diameter at breast height will increase to an average of 68 percent of all trees in Mexican spotted owl critical habitat. Modeling predicts average basal area is decreased from the existing condition in 20 years. Increasing basal area size classes for older trees and reducing medium aged over abundant size classes to natural range of variation benefits the Mexican spotted owl through reduction of over encroached forest conditions. Further, this would increase vertical and horizontal habitat heterogeneity providing roosting options, thermal and hiding cover for the Mexican spotted owl, and

habitat for a variety of prey species. By emphasizing for large trees, this should also provide for Mexican spotted owl life history needs (nesting and roosting) and provide for large snags and logs (Ganey 1999, Ganey and Vojta 2005).

Shade canopy created by the trees branches covering 40 percent or more of the ground.

In Mexican spotted owl critical habitat, the percent average of canopy cover is reduced from the existing condition. In protected and nest/roost recovery habitat, percent average of canopy cover remains at 60 percent or higher and 47 percent or higher in foraging/non-breeding recovery habitat. Retaining canopy cover allows for a thermal environment needed for nesting and roosting conditions for the Mexican spotted owl while allowing for prey base and for species that require interlocking crown habitat. Design features would preserve the recommended habitat conditions in critical habitat wherever possible while protecting this habitat from severe fire intensity or stand replacing effects from crown fire (see Fire Effects for alternative 2 below).

Large dead trees (snags) with a diameter at breast height of 12 inches or more.

Snags

In Mexican spotted owl critical habitat, standing snags increase from the existing condition of 1.6 snags per acre greater than or equal to 12 inches as a result of treatments under alternative 2. Snags per acre greater than or equal to 12 inches increases to 2.6 per acre in Mexican spotted owl critical habitat from alternative 2. This Primary Constituent Element is increased over time under the alternative 2. In addition, increasing key habitat elements for the Mexican spotted owl such as snags of various sizes to provide for nesting and roosting and for prey habitat follows guidance from the Mexican spotted owl Revised Recovery Plan (2012). This is a long-term benefit to the Mexican spotted owl because of treatment from alternative 2.

Primary Constituent Elements Related to Maintenance of Adequate Prey Species
High volumes of fallen trees and other woody debris.

Coarse Woody Debris

Coarse woody debris in Mexican spotted owl critical habitat increases from the existing condition (21 tons per acre) to 23 tons per acre as a result of treatments in alternative 2. This will increase prey base habitat which will benefit the Mexican spotted owl in its critical habitat.

A wide range of tree and plant species, including hardwoods.

Mixed conifer and ponderosa pine would be expected to respond favorably to thinning and broadcast burning treatments. The overall reduction of tree density along with creating openings in many areas would have the effect of exposing the forest floor to more sunlight and increasing understory diversity.

Plant species richness would increase following thinning and/or burning treatments that result in small, localized canopy gaps. Although Mexican spotted owl nest cores would remain relatively dense, Mexican spotted owl protected activity center treatments would provide for 10 percent openings across treatment areas from 0.1 to 2.5 acres in size. In recovery habitat, openings would occupy about 10 to 20 percent of the treatment area. The openings would help to promote plant species richness. The creation of openings in mixed conifer would allow for early seral species such as aspen and pine to regenerate and would have the effect of helping to maintain uneven-aged characteristics.

Design features are included focusing on retaining Gambel oaks and other hardwoods and coniferous species, but some short-term loss of plant diversity could occur during thinning operations, prescribed fires, or road relocation/maintenance/rehabilitation. In Mexican spotted owl recovery habitat, design features would manage for large oaks by removing conifers up to 18 inches diameter at breast height that do not meet the “old tree” definition within 30 feet of oak 10 inches diameter at root collar or larger.

Adequate levels of residual plant cover to maintain fruits, seeds, and allow plant regeneration

Understory

Herbaceous biomass in tons per acre increases slightly over the 20-year FVS model from treatments under alternative 2. Herbaceous biomass in tons per acre increases from 0.22 ton per acre in the existing condition to 0.25 ton per acre after 20 years of treatment from alternative 2. Treatments under alternative 2 for Shrub Biomass in tons per acre also increase as a result of treatments from alternative 2 (from 0.28 ton per acre in the existing condition to 0.43 ton per acre after 20 years of treatment from alternative 2). Increases in shrub and herbaceous biomass is more pronounced in some Mexican spotted owl habitat types. For example, in protected habitat the mixed conifer shrub biomass moves from 0.40 ton per acres in the existing condition to 0.73 ton per acre after 20 years of treatment. Increasing these PCEs important to prey base for the Mexican spotted owl is an added benefit to treatments in Mexican spotted owl critical habitat from this alternative. Cable operations in Mexican spotted owl critical habitat from alternative 2 could reduce understory under the cables in the short-term, with long term benefits (see Effects Common to Both Alternatives section) occurring on the acres treated with cable operations.

Alternative 2 Fire Effects

FVS modeling shows surface fuel loading in Mexican spotted owl critical habitat is reduced from the existing condition (50 tons per acre) to 38 tons per acre from alternative 2, over the 20 years.

In Mexican spotted owl critical habitat, the fire hazard index modeled 686,283 acres. Approximately 288,246 acres (42 percent) of the Mexican spotted owl critical habitat in the project area show a moderate, high, or extreme need for treatment categories of fire hazard index. Of these acres modeled 181,505 acres (26 percent) have a high or extreme need for treatment and would experience higher severity wildfire than would occur in a natural fire regime if no action is taken.

In Mexican spotted owl critical habitat, the moderate, high, and extreme need for treatment categories of fire hazard index are decreased from 288,246 acres (42 percent) in the existing condition to 167,961 acres (24 percent) after alternative 2 is implemented. The high and extreme need for treatment categories are reduced from 181,505 acres (26 percent) of all Mexican spotted owl critical habitat modeled in the existing condition to 71,964 acres (10 percent) after alternative 2 is implemented.

In Mexican spotted owl critical habitat, crown fire potential modeled 686,283 acres, with 242,642 acres (35 percent) that could experience active or conditional crown fire if no action is taken. Active crown fire in Mexican spotted owl critical habitat in the existing condition total 186,772 acres (27 percent) of this habitat type modeled in the project area that would experience high-severity crown fire if no action is taken.

In Mexican spotted owl critical habitat, the potential for active and conditional crown fire is decreased in alternative 2 compared to the existing condition from 242,642 acres (35 percent) to 95,894 acres (14 percent) after alternative 2 is implemented. Reducing active and conditional crown fires by this magnitude is a benefit to the Mexican spotted owl that would preserve Mexican spotted owl critical

habitat over time. Active crown fire risk is reduced from 27 percent of all Mexican spotted owl critical habitat in the project area to 12 percent after alternative 2 is implemented.

Alternative 2 Determination of Effect for Mexican Spotted Owl Critical Habitat

Based on the above analysis, alternative 2 may affect, is **likely to adversely affect** Mexican spotted owl critical habitat.

Alternative 3 – Focused Restoration

Alternative 3 would treat fewer acres in the Rim Country project area. The direct and indirect effects would be similar to alternative 2. Alternative 3 includes the same number of miles and acres of comprehensive restoration, while reducing the total number of acres thinned and treated with prescribed burning. In Mexican spotted owl critical habitat, 203,077 fewer acres would be thinned and burned. Savannah treatments in alternative 3 would be reduced by 3,450 acres, providing less restoration to benefit the Mexican spotted owl prey base.

The same analysis for alternative 2 regarding effects from implementation activities to Mexican spotted owl critical habitat applies to alternative 3, with less acres treated. While disturbance effects would be lessened slightly with alternative 3, the long-term effects and risk of habitat degradation from stand-altering wildfire or insect infestations would be greater (see below).

Forest conditions in Mexican spotted owl critical habitat from alternative 3 are similar to alternative 2, with fewer acres treated. Surface fuel is reduced from the existing condition while still promoting large trees and snags, coarse woody debris, and herb and shrub understory. Analysis for the effects to primary constituent elements of Mexican spotted owl critical habitat are the same as in alternative 2. Short-term negative effects to habitat from implementation will occur, though highly mitigated with design features, leading to long-term benefits to the habitat as a result of restoration treatments. Cable operations in Mexican spotted owl critical habitat from alternative 3 could reduce understory in cable corridors in the short-term, with long term benefits (see effects common to both alternatives section) realized in the acres treated with cable operations.

In Mexican spotted owl critical habitat, the moderate, high, and extreme need for treatment categories of fire hazard index are decreased from 288,246 acres (42 percent) in the existing condition to 212,591 acres (31 percent) after alternative 3 is implemented. The high and extreme need for treatment categories are reduced from 181,505 acres (26 percent) of all Mexican spotted owl critical habitat modeled in the existing condition to 115,803 acres (17 percent) after alternative 3 is implemented.

In Mexican spotted owl critical habitat, the potential for active and conditional crown fire is decreased in alternative 3 compared to the existing condition from 242,642 acres (35 percent) to 144,020 acres (21 percent) after alternative 3 is implemented. Active crown fire risk is reduced from 27 percent of all Mexican spotted owl critical habitat in the project area to 19 percent under alternative 3.

Alternative 3 Determination of effect for Mexican spotted owl critical habitat

Based on the above analysis, alternative 3 **may affect, is likely to adversely affect** Mexican spotted owl critical habitat.

Cumulative Effects for Mexican Spotted Owl and Mexican Spotted Owl Critical Habitat

Because of the size of the Rim Country project area and the large portion of the western Upper Gila Mountain Recovery Unit and a portion of the Basin and Range Recovery Unit that it occupies, the project area itself was considered adequate for assessing habitat effects on protected activity centers. Due to the potential for disturbance to owls, the cumulative effects analysis boundary was extended 0.5 mile beyond

the project area periphery to account for the spatial component of this analysis. Cumulative effects include the effects of alternative 1. The temporal component in this analysis was defined as 10 years for short-term effects and 30 years for long-term effects.

The effects from projects before 2000 are incorporated into existing conditions. Aspects of existing conditions that are a result of these early projects include a deficit in large trees and snags and even-aged conditions. Pre-2000 projects also had heavy selection pressure for preferred tree genetics to provide healthy trees with good form. This latter effect resulted from harvested areas being regenerated from planting stock or from the selected reserve trees left in seed tree harvest units. Wildlife habitat in the form of nesting, feeding, and loafing sites was reduced by selecting for disease-free trees with symmetric shapes, eliminating fork-top trees, trees with unusual branching patterns, and replanting with selected genetic stock from nurseries.

Cumulative Effects Alternative 1 – No Action

Alternative 1 would not contribute to the improvement of either forest structure or prey habitat within Mexican spotted owl habitat. The contributions of past, ongoing, and reasonably foreseeable actions would affect habitat for Mexican spotted owl and their prey, but no cumulative effects would result from Rim Country (such as, no change would occur either spatially or temporally to alter these effects of other actions on the landscape).

Maintaining existing conditions would extend the current deficit of trees greater than 24 inches in diameter. Current numbers of trees per acre greater than or equal to 18 inches in diameter, already below land management plan and recovery plan direction, would likely be maintained due to increases in mortality rates resulting from competition. Slow to stagnating tree growth rates would prolong the time required for mid-aged trees to grow into mature trees. Replacement of mid-aged trees by younger trees would occur at low rates because of current deficits in small size classes, delaying, limiting, or preventing the long-term attainment of desired conditions for mature and old-growth forest. Ponderosa pine is not a shade-adapted species. Therefore, consistently dense canopy cover would delay or prevent development of multi-storied and uneven-aged forest structure in the long term. Growth could be further suppressed and mortality rates increased if climate patterns continue toward hotter and drier growing conditions. Within-stand mortality resulting from competition for rooting space, water, and nutrient availability, vulnerability to insects and disease, and fire could lead to patches of more open conditions. This could reduce potential nesting and roosting habitat even in locations where individual trees might benefit and eventually grow into larger size classes.

Ponderosa pine-oak habitat would remain outside the natural range of variation in terms of tree densities and age-class distribution under alternative 1. Loss of large diameter oak would continue, as would the suppression of young oak by competing pine trees. Total basal area in oak may decline over time and would likely remain below desired conditions. Dense forest structure could increase the risk of insect and disease outbreaks occurring and increase the scale at which they occur. Stochastic events outside the natural range of variation could continue to slow or prevent development of new Mexican spotted owl nesting and roosting habitat.

Limited road closures would allow continued access to most of the existing roads footprint and would maintain the same threat to large snag persistence. Ecosystem function would continue to decline with continued tree encroachment into spring, channel, meadow, and aspen habitats.

The ability to retain sustainable and resilient ecosystems would be further compromised by vulnerability to high-severity fires. The overt threat of high-severity fire could limit options for treating uncharacteristic fuel loads through the use of unplanned ignitions, compounding the risk of high-severity fire through time. By not treating outside of Mexican spotted owl habitat, the risk of high-severity fire

remains high from ignitions starting outside of ponderosa pine-oak habitats as well as fire igniting within Mexican spotted owl habitat.

Cumulative Effects Alternative 2 – Modified Proposed Action

Treatments in these areas would reduce the fire threat for Mexican spotted owl habitat within the respective project area, as well as reducing the threat of high-severity fire starting in these areas and burning habitat outside the project areas. Given the diameter limits employed and the generally low intensity of the treatments in Mexican spotted owl habitat, decreases in the risk of high-severity fire and improvements to understory vegetation and prey habitat are expected to be short term, before canopies expand and intercept light, rain, and snow, thereby reducing understory response in the long term.

Cumulative effects from reasonably foreseeable projects could include disturbance from noise and potentially from smoke. Implementation of the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim), could cumulatively degrade but retain Mexican spotted owl habitat, including protected activity centers and recovery habitat, in the short and long terms. However, the risk of high-severity fire eliminating Mexican spotted owl habitat would be reduced in the short and long terms.

Although smoke and noise can cross project boundaries, both largely disperse with distance. However, some areas where smoke settles could be at further risk of effects on owls where these projects share boundaries. All or most protected activity center treatments would have timing restrictions, cumulatively preventing treatments during the breeding season. The most common protected activity center treatment would be prescribed fire.

Given the various stages of planning and implementation, most project effects would be dispersed both spatially and temporally. Projects in Mexican spotted owl habitat are typically designed to improve habitat, or to reduce fuel loading and risk of crown fire while retaining habitat function, resulting in a decrease in risk of high-severity fire. Cumulatively there could be increased disturbance to individual MSOs from noise or smoke in the short term. Given restoration project objectives, the scale of the cumulative effects area, the distribution of Mexican spotted owl habitat across the project area, and the length of time over which treatments would be implemented (20 years of implementation and ten more years of obtained benefits through reduction of wildfire risk), cumulatively alternative 2 is not expected to negatively affect Mexican spotted owl population in the long term. Cumulatively, treatments in Mexican spotted owl habitat should move forest conditions toward desired conditions and decrease the risk of habitat loss to large-scale high-severity fire.

Cumulative Effects Alternative 3 – Focused Restoration Alternative

In protected activity centers, 24,045 fewer acres would be thinned and burned. In recovery nest/roost habitat, 7,545 fewer acres would be treated in alternative 3. In foraging/non-breeding Mexican spotted owl recovery habitat 51,920 fewer acres would be treated in alternative 3. Savannah treatments in alternative 3 would be reduced by 15,190 acres, providing less restoration to benefit the Mexican spotted owl prey base.

The same analysis for alternative 2 regarding disturbance from implementation activities applies to alternative 3, with less acres treated. While disturbance effects would be lessened slightly with alternative 3, the long-term effects and risk of habitat degradation from stand-altering wildfire or insect infestations would be greater.

Western Yellow-billed Cuckoo

Alternative 1 – No Action Direct and Indirect Effects

Under alternative 1, habitat conditions for wildlife would largely remain in their current condition. Mechanical thinning and prescribed fire would still occur as a result of current and reasonably foreseeable projects. However, the landscape would continue to move away from desired conditions (see Affected Environment above and in the Silviculture and Fire Specialist reports). Alternative 1 would have no direct effect on the yellow-billed cuckoo; however, there would be substantial indirect effects. Dense forest conditions would still occur and the high fire hazard potential would persist. Large crown-wildfires could adversely affect potential habitat by destroying understory and overstory vegetation. As a result, overland flow would increase, and soil erosion would increase with potentially high sediment loads. Water quality and riparian conditions would be adversely affected on a wide-scale basis (See water and riparian specialist report), resulting in indirect adverse effects.

Under alternative 1, there would be no restoration of springs and riparian areas. These areas would continue to exhibit downward trends in functional condition or remain in static condition for the foreseeable future (See water and riparian specialist report), resulting in degradation of potential habitat for cuckoos.

Denser forest conditions produce lower values in understory biomass (pounds per acre). Under alternative 1, understory biomass would continue to decline over the next 40 years. Limited cover around tanks and riparian areas as well as the limited herbaceous understory across the project area, would continue to reduce the likelihood that cuckoos would successfully locate and nest in these areas.

Determination of Effect

Alternative 1 **may affect and is likely to adversely affect** the western yellow-billed cuckoo.

Alternative 2 – Modified Proposed Action

Prescribed fire and mechanical thinning projects have occurred and are expected to continue in habitat used by yellow-billed cuckoo on national forests where cuckoos occur. Therefore, proposed fire and non-fire treatments may directly and indirectly affect cuckoos by removing suitable habitat and displacing breeding or foraging birds, and/or by disturbing cuckoos where suitable habitat is not displaced, but within the vicinity of project activities. Effects to the yellow-billed cuckoo and its Critical Habitat from cable operations are not expected. No areas where the yellow-billed cuckoo could potentially occur in the project area are proposed for cable operations.

These kinds of projects could have short-term adverse effects on yellow-billed cuckoo habitat by reducing cover, affecting water quality, and reducing prey abundance. Implementation of proposed activities and associated fire and smoke can alter yellow-billed cuckoo behavior by creating visual, noise, and physiological disturbance. Yellow-billed cuckoos may exhibit avoidance, ranging from less than a day where visual and noise disturbance is temporary to more than one breeding season where breeding and foraging habitat have been removed. If yellow-billed cuckoos are present at the time of thinning or prescribed burning activities, individuals could abandon their roosting and nesting sites.

If nests are abandoned, young or eggs would be lost. Any individuals present in or adjacent to treated areas could also experience effects from the loss of prey availability, fire, and visual, noise, and smoke disturbance. The effects could range from habitat use changes, activity pattern changes, increased stress responses, decreased foraging efficiency and success, reduced reproductive success, increased predation risk, and intraspecific diminished communication (NoiseQuest n.d. [2012]; Pater et al. 2009). These responses could vary depending on the nature of the disturbance, but would be expected to decrease as the distance from the activity increases.

Although design features are included in this alternative to mitigate effects from treatments, adverse effects on yellow-billed cuckoos and habitat are still likely to occur during migration and the early part of the breeding season. Prescribed burning just prior to arrival would reduce the available foraging habitat and prey species to cuckoos. Yellow-billed cuckoo home ranges are large, usually at least 50 acres in size. As such, effects on yellow-billed cuckoos and habitat from thinning and prescribed fire might occur within yellow-billed cuckoo riparian breeding habitat and adjacent foraging habitat up to 0.5 mile away.

Prescribed fire, and to a lesser extent mechanical thinning, would also benefit yellow-billed cuckoos by maintaining long-term ecosystem function on these fire-adapted landscapes. Thinning and fire would promote seral stage diversity and reduce fuel build-up that might otherwise result in a stand-replacing, high-severity fire. The regenerating and resprouting trees, shrubs, and herbaceous vegetation resulting from fire would increase the insect production needed by cuckoos to raise young.

Prescribed burning would occasionally use riparian drainages as control lines where no natural physical barriers, roads, trails, or openings can be used. Design features described above would ensure that effects on riparian habitat would be spread across the landscape and temporally separated. In this way, there would never be a case over the lifespan of the project that a single riparian drainage would be treated along its entire length.

Cumulative Effects from Alternative 2

The area analyzed for cumulative effects for yellow-billed cuckoo is within the project area's riparian corridors and a 0.5-mile buffer. The temporal boundary is 30 years, including 20 years of implementation and 10 years of riparian system benefits from those treatments. Watershed health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves National Forests), and other restoration work, such as in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating cuckoo habitat in Rim Country would be reduced in the short and long terms.

Climate change, in combination with drought cycles, is likely to exacerbate existing threats to the yellow-billed cuckoo's habitat in the southwestern United States, now and into the foreseeable future. Implementation of restoration projects such as Rim Country should cumulatively mitigate some of the long-term effects from climate change on yellow-billed cuckoo habitat.

Determination of Effect

Implementation of alternative 2 **May affect, is Likely to Adversely Affect** the Yellow-billed Cuckoo.

Reasoning:

- Prescribed burning in yellow-billed cuckoo riparian habitat might occur during migration and the early part of nesting season (May 15 – July 1), but it would not occur during the height of the breeding season (July 1 – September 30).
- Treatment in riparian and adjacent foraging habitat for the yellow-billed cuckoo prior to the breeding season might promote tree resprouting, herbaceous growth, and insect production during the monsoon when yellow-billed cuckoos are nesting.
- Low to moderate burn severity would target ground cover and dense shrubs in yellow-billed cuckoo riparian habitat.
- Although yellow-billed cuckoos might be adversely affected by loss of habitat and disturbance in the short-term in riparian and adjacent foraging habitat for the yellow-billed cuckoo, the proposed

activities would benefit yellow-billed cuckoos in the long term by reducing the risk of a high-severity fire that would destroy breeding and foraging habitat.

While yellow-billed cuckoos might be disturbed by proposed activities occurring in riparian and adjacent habitat while they are present (May 15 – September 30), design features in appendix C would avoid or minimize the adverse effects of the proposed activities, including on yellow-billed cuckoo breeding and foraging habitat. Although suitable habitat occurs in the project area, the habitat is at the species outer limits (higher elevation with smaller reaches of riparian habitat) and may not support a breeding population of yellow-billed cuckoos.

Alternative 3 – Focused Restoration Alternative

Direct and indirect effects for Alternative 3 would be the same as with alternative 2. Alternative 3 includes the same number of miles and acres of riparian restoration. However, the acres of forested acres thinned and treated with prescribed burning would be reduced. Project design features have been developed (included in alternative 2 analysis for the yellow-billed cuckoo above) to reduce the potential of effects on nesting and foraging yellow-billed cuckoo habitat.

Cumulative Effects – Alternative 3

Cumulative effects would be the same as alternative 2 except that alternative 3 would treat less acres overall proposing 528,850 acres of treatment (462,210) resulting in less watershed restoration.

Determination of Effect – Alternative 3

Implementation of alternative 3 **May affect, is Likely to Adversely Affect** the Yellow-billed Cuckoo.

Mexican Wolf

Alternative 1 – No Action

Under alternative 1, habitat conditions for wildlife would largely remain in their current condition. Mechanical thinning and prescribed fire would still occur as a result of current and reasonably foreseeable projects. However, the landscape would continue to move away from desired conditions (see Affected Environment above and in the Silviculture, Fire Ecology, and Air Quality Specialist Reports). Alternative 1 would have no direct effect on Mexican wolves. Dense forest conditions would still occur and the high fire hazard potential would persist. Large crown fires could adversely affect potential habitat by destroying understory and overstory vegetation.

Under alternative 1, there would be no restoration of springs and riparian areas. These areas would continue to exhibit downward trends in functional condition or remain in static condition for the foreseeable future (see water and riparian specialist report), resulting in degradation of conditions for potential prey species.

Determination of Effect

Alternative 1 would have **No Effect** to the Mexican wolf.

Alternative 2 – Modified Proposed Action

The Rim Country Project lies within the Blue Range Wolf Recovery Area where Mexican wolf denning has not occurred. The Mexican wolf has not been reported denning in or near the Rim Country project area, though dispersing adults have moved through the area and could potentially den in the project area in the future.

If conflicts occur, the Forest Service would work with the Mexican Wolf Field Team to arrive at a solution. Actions taken on the other Ranger Districts where wolves occur included placing temporary restrictions around a wolf den site.

Dispersing reintroduced Mexican wolves might be disturbed during implementation of thinning and prescribed fire. Due to the mobility of the species, reintroduced wolves are likely able to avoid areas receiving treatment. Direct effects from thinning operations would not be expected to affect denning wolves because of the added design feature to limit disturbance. Design feature WL044 would add in reduce potential impacts to the species by temporarily restricting access and disturbance activities within a 1-mile radius around active Mexican wolf dens between April 1 and July 31, and around active rendezvous sites between June 1 and September 30.

Thinning and management-ignited fire alters prey species habitat to various degrees. Especially in areas that sustain low to moderate-intensity burns, there would be an eventual, relatively short-term increase in forage and browse used by some prey species.

Cumulative Effects from Alternative 2

The cumulative effects analysis area for the Mexican wolf is the project area and a 10-mile buffer outside of the project boundary to include dispersing animals. The temporal boundary is 25 years to include 20 years of implementation, and 5 years of effects following treatments. Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District), Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively, the risk of high-severity fire eliminating Mexican wolf habitat in Rim Country would be reduced in the short and long terms.

Determination of Effect

Potential effects on the Mexican wolf reintroduction project from the Rim Country Project have been analyzed and found to be insignificant and discountable. Mexican wolves have long endured in fire-adapted ecosystems and the implementation of this alternative would not adversely affect the reintroduction effort. Communication with the Mexican wolf Interagency Field Team would allow project managers to avoid treatment in close proximity to dens, or during the wolf denning season.

By definition, a non-essential experimental population is not crucial to the continued existence of the species. Therefore, no management activities associated with the Rim Country Project would affect this 10(j) population so designated that could lead to a jeopardy determination for the entire species. The management activities associated with the Rim Country Project in the 10(j) area with Mexican wolves are **not likely to jeopardize the continued existence of the Mexican wolf.**

Alternative 3 – Focused Alternative

The direct and indirect effects from alternative 3 would be similar to those from alternative 2. Alternative 3 includes the same number of miles and acres of riparian restoration. However, the acres of forested acres thinned and treated with prescribed burning would be reduced. A design feature was included (see alternative 2 analysis above) to reduce the potential of effects on denning Mexican wolves.

Cumulative Effects

Cumulative effects would be the same as alternative 2 except that alternative 3 would treat less acres overall proposing 528,850 acres of treatment (462,210) less than alternative 2 which would result in less forest restoration and providing less risk of severe wildfire effects.

Determination of Effect

Implementation of alternative 3 is **not likely to jeopardize the continued existence of the Mexican wolf.**

Forest Service Sensitive Species

Northern Goshawk

Alternative 1 – No Action

Direct and Indirect Effects

Direct effects are those caused by the management activities and occur at the same time and place. There would not be any direct effects on the northern goshawk from alternative 1 because there would be no Rim Country treatment activities occurring.

Indirect effects are those effects caused by the action and are later in time and/or further removed in distance. The physical changes to the quantity and quality of the northern goshawk's habitat and that of its prey species are indirect effects and are addressed here and in the Management Indicator Species analysis. Following sections are site-specific details regarding the effects of the no action alternative.

Vegetation Changes

Under the no action alternative, most of the overall landscape would move toward desired conditions more slowly than the other alternatives, while some areas may not move toward desired conditions at all. Post-fledging family areas (PFAs and lands outside PFAs (LOPFAs)) would have less age-class diversity than either of alternatives 2 and 3.

Specifically, alternative 1 would have the lowest proportion in grass-forb-shrubs, seedlings, and saplings; the highest proportion in mid-aged forest; and the lowest proportion in the older age classes.

Post-fledging Family Areas (PFAs)

In PFAs the FVS modeling of the effects of treatments on northern goshawk under alternative 1 show that the average of all basal area and canopy cover would continue to increase slightly. Mid-aged forest (BA3, 5-12 inches, and BA4, 12-18 inches) would continue to dominate the landscape and represent a huge shift in the natural range of variation for the forested ecosystem. Trees greater than 18 inches increase from 27 percent of all trees in these age classes in the existing condition to 31 percent as a result of no treatment after 20 years.

Snags of all size classes important to prey species would remain the same after 20 years of no management. Coarse woody debris and downed logs important to prey species would increase over 20 years. Herbaceous and shrub layers would show no improvement over time under alternative 1.

Lands outside of PFAs (LOPFAs)

The three land management plans have guidance to manage toward uneven-age stand conditions. In LOPFAs, alternative 1 would have the slowest progress of all alternatives toward having age classes in uneven-aged (desired) condition.

In LOPFAs, FVS modeling of effects on northern goshawk under alternative 1 shows that the average of all basal area and canopy cover would continue to increase. Mid-aged forest (BA3, 5-12 inches, and BA4, 12-18 inches) would continue to dominate the landscape and represent a huge shift in the natural range of variation of the forested ecosystem. Trees greater than 18 inches increase from 24 percent of all trees in these age classes in the existing condition to 28 percent as a result of no treatment after 20 years.

Fuel loads in average of tons per acre increase from 17 tons per acre in the existing condition to 22 tons per acre after 20 years under alternative 1.

Fire hazard index and risk of crown fire was modeled in PFAs as a result of alternative 1. Of the 41,590 acres modeled, 13,459 acres (33 percent) of the PFAs in the project area could potentially experience high-severity wildfire. This is increased from 28 percent in the existing condition. The risk of

crown fire was modeled in PFAs as a result of alternative 1. Approximately 15,950 acres (39 percent) of PFAs in the Rim Country project area are at risk of experiencing active or conditional crown fire, which is increased from 36 percent in the existing condition.

In Lands Outside of PFAs, fire hazard index and risk of crown fire were modeled. Under alternative 1, the fire hazard index and risk of crown fire increases. In PFAs, the high and extreme need for treatment categories of fire hazard index increase to 28 percent (231,579 acres) from 26 percent in the existing condition. The risk of active and conditional crown fire in lands outside of PFAs is increased from the existing condition from 56 percent to 60 percent on 468,923 acres.

Cumulative Effects from Alternative 1

The cumulative effects analysis boundary is defined as the project area and a one-half mile buffer around the outside of the project boundary and includes effects for a period of 20 years beginning with implementation of the Rim Country Project. The no action alternative would maintain the current fire risk to northern goshawk habitat and adjacent forest lands. The cumulative effects of the no action alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place northern goshawk habitat and adjacent habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow, fuels continue to accumulate, and the effects from climate change persist, thus continuing to have negative effects on northern goshawk.

Determination of Effect

Alternative 1 **may affect individual northern goshawks, but is not likely to cause a trend toward federal listing or loss of viability.**

Effects Common to Both Action Alternatives

Because northern goshawks are potential predators of Mexican spotted owls and northern goshawk survey crews could disturb nesting and roosting Mexican spotted owls in protected activity centers, a 0.5-mile buffer beyond protected activity center boundaries would be excluded from northern goshawk surveys to avoid harassment of nesting Mexican spotted owls.

Mechanical Treatments

Habitat features that appear to be important to a variety of northern goshawk prey species would be retained or improved with alternatives 2 and 3. These habitat features include snags, downed logs, large trees, openings and associated herbaceous and shrubby vegetation, interspersed, and canopy cover (Reynolds et al. 1992, USDI FWS 1998a, Squires and Kennedy 2006). Design criteria have been identified to reduce effects on northern goshawks in alternatives 2 and 3 (appendix C).

Noise disturbance from logging trucks was monitored for nesting northern goshawks in a study on the Apache-Sitgreaves National Forests. The study was coordinated between the Apache-Sitgreaves National Forests, Rocky Mountain Research Station, U.S. Army, and a private sound consultant. Results from this field-based, controlled experiment found no evidence of negative effects from truck noise. Observed northern goshawk response to logging truck noise was limited to, at most, looking in the direction of the hauling road (Grubb et al. 2012).

Disturbance from hauling would vary based on which nest site is selected during the time that hauling occurs. Therefore, road disturbance, even with thousands of truck trips, may cause little or no disturbance.

Road work and use of haul roads could increase the potential for northern goshawk collision with vehicles. Little information is available on how frequently collisions might occur and what conditions might increase or lessen the vulnerability of northern goshawks.

Vehicles associated with treatments passing through PFAs would follow the posted speed limit to reduce the hazard of collisions. Given the adult northern goshawk's natural agility in flight and the size and noise of the large trucks and chip vans, adult northern goshawks would be expected to avoid colliding with log trucks passing through the PFA. Newly fledged northern goshawks still developing their flight skills may have a slightly higher potential for colliding with a large truck, but the reduced speed of the trucks and natural agility of northern goshawks should minimize this potential. Northern goshawks migrating or dispersing through unfamiliar terrain may be at higher risk than resident birds.

Vehicle activity would alternate throughout the Rim Country landscape as different contracts are issued and would concentrate in particular areas while the work is being conducted. Activity would be expected to increase well above existing traffic levels for about two years until operations shift to other areas.

In summary, hauling of wood products or road gravel would be unlikely to cause noise disturbance to nesting northern goshawks or result in collisions, but there is the potential to disrupt reproduction and rearing of young by, at most, one or two pair of northern goshawks and might result in the injury or death of one or more young.

Prescribed Fire

The land management plans allow for wildfire to occur within PFAs during and outside the breeding season, although human disturbance should be limited during the breeding season so that northern goshawk reproductive success is not affected by human activities. Low-intensity ground fires are allowed at any time, but high-intensity crown fires are not acceptable in PFAs or nest areas.

The effects from burning would be influenced by the life history of the northern goshawk at the time of the fire, as well as several fire-related factors including pre-fire fuel loading and structure, the season when the fire occurs, fire intensity, and fuel consumption. Burning effects would also be related to how similar burning conditions are to the natural fire regime. Knapp et al (2009) provide a good overview of the ecological effects of prescribed fire season.

Northern goshawks and their prey could be directly affected by the heat, flames, and smoke of a fire or indirectly by habitat modification. Animals that live in fire-adapted ponderosa pine forests have presumably developed behavioral adaptations to escape fires or find refugia and allow populations to persist (Knapp et al 2009).

Incubating adults or young northern goshawks unable to fly could inhale smoke from prescribed fires. Smoke could result in an extended absence of the adults during brooding or when the chicks are very young. This could result in increased vulnerability to predators or to unfavorable weather, or reduced feeding. Smoke is likely to be worse during first-entry burning, under conditions where fuels have built up to unnatural levels due to years of fire suppression. Smoke would be expected to be more within the range of natural variation after a first-entry burn and to have less intensity or duration. There would be a low likelihood of loss of nest trees or northern goshawks due to the heat, flames, or smoke of a prescribed fire with the design features for this project. Design criteria have been identified to reduce disturbance-related effects on northern goshawks in alternative 2 (appendix C).

Wildfire Modeling

Fire hazard index was modeled for one treatment and two prescribed burns in 58,337 acres of PFAs within the project area. Potential for crown fire was also modeled in PFAs and ponderosa pine habitat type in the project area by alternative with acres and percentages (See terrestrial wildlife specialist report). Design features to reduce the magnitude of short-term indirect effects from alternative 2 are within appendix C.

Alternative 2 – Modified Proposed Action

Direct and Indirect Effects

There are 106 PFAs on the Apache-Sitgreaves, Coconino, and Tonto National Forests, totaling 55,608 acres in the Rim Country project area. Approximately 35,549 acres of PFA habitat would be treated with mechanical thinning and/or prescribed fire in the proposed action. Cable operations could occur on 676 acres in northern goshawk PFAs from alternative 2. Project treatments primarily decreased the number of trees less than 14 inches diameter at breast height. The degree of treatment intensity is highly variable, with some projects not cutting trees greater than 12 inches diameter at breast height and others looking to lower the threat of high-severity fire in northern goshawk habitat. The overall ratio of trees greater than 12 inches diameter at breast height is likely to increase as a result of removing smaller trees and increasing the growth and survivability of larger trees. Total basal area of pine would decrease in the short term, but because the focus is on small trees, basal area might not substantially change. Overall basal area would be expected to increase in the long term.

Gambel oak is not targeted for removal, but prescribed fire would likely top-kill small diameter oak, potentially decreasing oak basal area in the short term. However, design features should ensure retention of large diameter oak and small oak commonly sprout vigorously after fire. The total basal area of Gambel oak is not expected to change substantially in the long term. Created canopy gaps, interspaces, and tree groups should benefit prey species and thinning should hasten tree growth, improving northern goshawk habitat.

Changes are expected in northern goshawk prey habitat. Decreases would occur in course woody debris, logs, and snags, commonly decreasing structure in prey habitat in the short term. Burn prescriptions and ignition techniques should limit these losses. Burned snags fall and provide logs, and trees killed by fire would become snags. However, the longevity of fire-killed snags is less than that of snags formed from other processes. However, maintenance burning should provide pulses of snags and logs through time. Less course woody debris is expected to be present in the short term as a result of prescribed fire. Thinning and prescribed burning should increase tree growth rates and self-pruning of lower tree branches should replenish course woody debris in the long term. Improving growing conditions should decrease density-related mortality of larger and older trees. Improving recruitment into the larger size classes would improve northern goshawk habitat and the ability to provide large snags that remain on the landscape longer than smaller diameter or fire-created snags. The combination of thinning and prescribed burning should improve species richness in the herbaceous understory, increase plant abundance, and improve fruit and seed production.

PFA Vegetation Changes

Mid-aged forest (BA3, 5-12 inches, and BA4, 12-18 inches) would be treated to attain the desired condition, reducing these size classes to better represent uneven-aged management. Trees greater than 18" increase from 27 percent of all trees in these age classes to 57 percent as a result of treatment after 20 years from alternative 2. Snags of all size classes important to prey species would continue to increase. Coarse woody debris and downed logs important to prey species would increase over 20 years. Also important to northern goshawk prey species, herbaceous and shrub layers would increase over time under alternative 2.

Lands Outside of PFAs (LOPFA)

In LOPFAs, FVS modeling on 758,581 acres of ponderosa pine habitat shows the average of all basal area and canopy cover would decrease under alternative 2. Mid-aged forest (BA3, 5-12 inches, and BA4, 12-18 inches) would be greatly reduced under alternative 2, bringing the age class distribution to desired condition after 20 years of treatment. Trees greater than 18" increase from 24 percent of all trees in these

age classes to 48 percent as a result of treatment after 20 years from alternative 2. Cable operations could occur on 45,992 acres in northern goshawk foraging habitat from alternative 2.

Snags of all size classes important to prey species would continue to increase from existing conditions. Coarse woody debris and downed logs important to prey species would increase over 20 years of implementation. Herbaceous and shrub layers, also important for prey species, would be increased under alternative 2.

Fire Effects

In both PFAs and in ponderosa pine habitat, fuel loads in average of tons per acre decrease significantly from the existing condition to less than 10 tons per acre after 20 years under alternative 2.

In PFAs, of the 41,590 acres modeled, high or extreme severity need for treatment categories of fire hazard index are decreased from 28 percent in the existing condition to 7 percent on 2,832 acres. In PFAs, risk of experiencing active or conditional crown fire is decreased from 36 percent in the existing condition to 12 percent on 5,071 acres.

In Lands Outside of PFAs, high or extreme severity need for treatment categories of fire hazard index are decreased from 26 percent in the existing condition to 17 percent on 147,717 acres. In Lands Outside of PFAs, the risk of active and conditional crown fire is decreased from 56 percent in the existing condition to 38 percent on 311,384 acres.

Determination of Effect

Considering direct, indirect, and cumulative effects, implementation of alternative 2 **may affect individual northern goshawks, but is not likely to cause a trend toward federal listing or loss of viability.**

Cumulative Effects for Alternative 2

For alternatives 2 and 3, the majority of acreage identified as part of the cumulative effects analysis occurs in LOPFA habitat, and the majority of past, current, and foreseeable future treatment acres are prescribed fire only. Most of the proposed treatments in alternatives 2 and 3 are mechanical thinning with prescribed fire with alternative 2 cumulatively treating more acres whereas alternative 3 would have the fewer.

Cumulatively, restoration treatments would contribute toward improving forest health, vegetation diversity, and vegetation composition in northern goshawk habitat under alternatives 2 and 3. This would aid in sustaining old forest structure over time and moving forest structure toward desired conditions, although on more acres in alternative 2 than in alternative 3. Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating wolf habitat in Rim Country would be reduced in the short and long terms.

Treating within current and reasonably foreseeable projects when added to treatments in Rim Country would reduce fire threat for northern goshawk habitat within the respective project area as well as reducing the threat of high-severity fire starting in these areas and burning habitat outside the areas. In addition, cumulative improvements to understory vegetation and prey habitat are expected to occur in northern goshawk habitat and be more persistent in the long term compared to more conservative treatments in Mexican spotted owl habitat that are employed because Mexican spotted owls have different habitat requirements than northern goshawks.

Cumulative effects from reasonably foreseeable projects could include disturbance from noise and potentially from smoke but could collectively improve northern goshawk habitat, including PFAs, because the risk of high-severity fire eliminating northern goshawk habitat would be reduced in the short term and long term. Although smoke and noise can cross project boundaries, both largely disperse with distance. However, some areas where smoke settles could have longer duration short term effects. Other projects, such as the CC Cragin and Beaver Creek Watershed Protection and Fuels Reduction Projects could cumulatively increase effects on northern goshawks in PFAs adjacent to shared boundaries.

Many current and reasonably foreseeable projects would overlap temporally. It is conceivable that actions would be occurring in PFAs in multiple locations within the 4FRI boundary. However, all or most PFA mechanical treatments or activities would have timing restrictions, postponing treatments until after the breeding season. Wildfire could occur at any time. Adult northern goshawks would be expected to adapt to fire because it inhabits ponderosa pine, which is a fire-adapted vegetation type in the southwest.

Given the various stages of planning or implementation, most project effects would be dispersed both spatially and temporally. Projects in northern goshawk habitat are typically designed to improve habitat, or to degrade elements of habitat structure while retaining habitat function, resulting in a decrease in risk of high-severity fire. Cumulative effects would likely increase disturbance to individual northern goshawks from noise or smoke in the short term., and effects are not expected to affect fecundity because of timing restrictions. Given typical project objectives, the spatial scale of the cumulative effects area, the distribution of northern goshawk habitat across the project area, and the length of time over which treatments would be implemented (10 or more years), cumulative effects are not expected to negatively affect the northern goshawk population in the long term. Overall, treatments in northern goshawk habitat should move forest conditions in the cumulative effects area toward desired conditions and decrease the risk of habitat loss to large-scale high-severity fire.

Alternative 3 – Focused Alternative

Direct and Indirect Effects

Direct and indirect effects would be similar to alternative 2.

PFA Vegetation Changes

Mid-aged forest (BA3, 5-12 inches, and BA4, 12-18 inches) size classes would be lowered from alternative 3 treatments, though not to the desired conditions. Trees greater than 18 inches increase from 27 percent of all trees in these age classes to 46 percent as a result of treatment after 20 years from alternative 3. Snags of all size classes important to prey species would continue to increase. Coarse woody debris and downed logs important to prey species would be maintained over 20 years. Herbaceous and shrub layers would be increased over time under alternative 3. Cable operations could occur on 615 acres of northern goshawk PFAs from alternative 3.

Lands Outside of PFAs (LOPFA)

In LOPFAs, FVS modeling shows that the mid-aged forest (BA3, 5-12 inches, and BA4, 12-18 inches) would be greatly reduced under alternative 3, bringing these age classes closer to desired conditions after 20 years. Trees greater than 18 inches increase from 24 percent of all trees in these age classes to 39 percent as a result of treatment after 20 years from alternative 3. Cable operations could occur on 35,772 acres of northern goshawk foraging habitat from alternative 3.

Snags of all size classes important to prey species would continue to increase. Coarse woody debris and downed logs important to prey species would be maintained over 20 years. Herbaceous and shrub layers, also important for prey species, would be increased under alternative 3.

Fire Effects

In both PFAs and in ponderosa pine habitat, fuel loads in average of tons per acre increase from 16 tons per acre in the existing condition to less than 14 tons per acre after 20 years under alternative 3.

In PFAs, of the 41,590 acres modeled, high or extreme severity need for treatment categories of fire hazard index are decreased from 28 percent in the existing condition to 11 percent on 4,661 acres. In PFAs, risk of experiencing active or conditional crown fire is decreased from 36 percent in the existing condition to 17 percent on 6,808 acres.

In Lands Outside of PFAs, high or extreme severity need for treatment categories of fire hazard index are decreased from 26 percent in the existing condition to 24 percent on 196,436 acres. In Lands Outside of PFAs, the risk of active and conditional crown fire is decreased from 56 percent in the existing condition to 47 percent on 387,660 acres.

Determination of Effect

Considering direct, indirect, and cumulative effects, implementation of alternative 3 **may affect individual northern goshawks, but is not likely to cause a trend toward federal listing or loss of viability.**

Cumulative Effects for Alternative 3

Cumulative effects for alternative 3 are the same as those for alternative 2.

Bald Eagle

Alternative 1 – No Action

Under alternative 1, current and reasonably foreseeable projects would still be implemented in the Rim Country project area. Wildfire modeling in the ponderosa pine habitat type by alternative show that of the 553,137 acres of ponderosa pine habitat type, 407,189 acres (81 percent) have the potential to experience high-severity wildfire under alternative 1. Crown fire potential in ponderosa pine habitat from Alternative 1 could occur in 480,996 acres (87 percent) of this habitat type. Dense forest conditions would still occur across the project area, and the high fire hazard potential would continue to place potential bald eagle nesting, roosting, and foraging habitat at risk with respect to stand-replacing fire.

Tree densities would continue to be high, slowing or stagnating growth into larger diameter classes, thereby limiting the development of roosting and perching habitat. Meadows, grasslands, and savannas would continue to be encroached by trees, limiting potential foraging areas.

Determination of Effect

Because of the design features included for both action alternatives to mitigate disturbance to eagles, alternative 1 **would not result in take** as defined in the Bald and Golden Eagle Protection Act for bald eagles.

Effects Common to Both Action Alternatives

Direct effects would be from activities that cause disturbances (smoke, auditory or visual) to bald eagles nesting or foraging within or adjacent to the project area. Under the action alternatives (the modified proposed action and the focused alternative), there would be no direct adverse effects on nesting eagles as project design features would eliminate disturbance near known nesting sites. In bald eagle breeding areas, mechanical treatments within 500-1,000 feet of bald eagle nest trees or nest sites would only occur outside of the breeding season (January 1st to August 31st), unless the nest is determined to be inactive by the District Biologist in coordination with AGFD and USFWS. Concentrations of smoke that might settle in an area for more than one or two nights when a female is on the nest could have adverse effects on

individuals. Prevailing southwest winds and the topography of the area typically act to lift smoke, carrying it away from ignition sites. Nests on cinder cones and other raised topographic features or in canyons immediately adjacent to the Mogollon Rim, are not expected to have smoke settle in them long enough to cause measurable effects on eagles because of the air movement in these landscape-scale features. Conversely, nests in small canyons or valleys might incur effects from dense smoke settling near nesting locations.

When smoke settles into low-lying areas it typically does not last more than one or two nights. Limited smoke at nest locations would be expected to expose adult eagles to negligible effects as this would repeat an aspect of their evolutionary environment (Horton and Mannan 1988, Prather et al. 2008). However, on occasion dense smoke may settle into specific nest locations. Dense smoke settling into nest areas early in the season (January through June) could disturb brooding females. If the female is flushed long enough to affect incubation, this could result in loss of viability of the eggs. Dense smoke settling for multiple consecutive nights could affect the developing lungs of nestlings. Unlike mammals, damaged avian lungs do not repair themselves through time (Rombout et al. 1991). Triggering a female to discontinue incubating eggs or affecting the lung development of nestlings would constitute long-term adverse effects. Outside of these examples, smoke settling in nest locations would typically be short-term and not likely to cause adverse effects.

Project activities would be restricted within 500 feet of known bald eagle winter roost sites from October 15 to April 15, unless, in coordination with AGFD and USFWS, it is determined eagles are not using the winter roost at that time. Drift smoke from prescribed fire would be expected. Potential roost treatments would be designed to maintain and develop roost characteristics such as large trees and snags, while reducing surface fuel loading and crown fire potential within the roost, increasing roosting habitat for eagles in the project area.

There would be no effect on nesting or roosting eagles; however, short-term disturbance to foraging bald eagles would occur during mechanical treatments, prescribed burning, hauling of wood products, and other project activities that may cause visual or auditory disturbance. Prescribed burning and mechanical treatment would occur annually; however, these are short-term effects and would be minimized due to activities being temporally and spatially separated. Prescribed burning effects would dissipate over time as first-entry burns would consume accumulated surface fuels, raising crown bulk height and reducing crown bulk density. In maintenance or second-entry burns in ponderosa pine cover types, fuel loads would be significantly lower and produce low-severity effects with fewer emissions. Disturbances would be localized, of short duration, and might affect individual birds but would not affect the overall distribution or reproduction of the species.

Indirect effects on the bald eagle include effects on eagle habitat, eagle prey species, or prey species habitat. No adverse effects on prey species or prey species habitat are anticipated. Indirect effects on habitat would occur from treatments that modify the number of trees in a group of suitable roost trees, as eagles prefer to roost in large trees in close proximity to each other. However, thinning would improve old tree longevity, resulting in beneficial effects. In RUs with documented bald eagle use, snags would slightly increase after treatment (2020) and continue to increase in the long term. Ignition techniques and site preparation would reduce potential mortality in these components from burning activities.

The modified proposed action (alternative 2) would develop older larger tree size classes which could be used as future winter roost sites for bald eagles.

Determination of Effect

Because of the design features included for both action alternatives to mitigate disturbance to eagles, alternatives 2 and 3 **would not result in take** as defined in the Bald and Golden Eagle Protection Act for bald eagles.

Cumulative Effects

The cumulative effects analysis area for bald eagles is the ponderosa pine habitat within the project area and a 0.5-mile buffer outside the project boundary. The temporal boundary is 30 years to include the effects of 20 years of implementation with effects from treatments lasting 10 years of riparian benefits following implementation.

Short-term effects added to similar effects from nearby projects were considered. Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating wolf habitat in Rim Country would be reduced in the short and long terms.

Implementation of other project activities could occur simultaneously; however, it is not anticipated that effects from those activities would combine with the effects from the Rim Country Project to produce negative effects. Both action alternatives would improve and develop quality potential nesting and roosting habitat by developing groups of large trees and snags that are more fire resistant. This positive effect would combine with similar effects from activities such as the Travel Management Rule efforts, which may decrease the frequency of disturbance on the majority of potential roost sites, and slightly counteract the effects from utility line and road construction and maintenance as well as short-term disturbances from vegetation management and prescribed fire.

Alternative 3 would treat less acres overall proposing 528,850 acres of treatment (462,210) less than alternative 2 which would result in less overall watershed restoration and providing less risk of severe wildfire effects than alternative 2.

Golden Eagle

Alternative 1 – No Action

There would be no direct effects on golden eagles as no habitat-altering activities or disturbance associated with project implementation would occur. Alternative 1 would not treat meadows, savannahs, or grasslands within the project area and trees would continue to encroach, reducing potential habitat for small mammals and consequently golden eagles. Tree densities would continue to be high, slowing growth into larger diameter classes and thereby limiting the development of larger diameter (18 inches or larger) trees important for nesting, roosting, and perching. Habitat conditions would remain in their current condition, notwithstanding natural processes. Dense forest conditions would still occur and the high fire hazard potential would continue to place potential golden eagle breeding, nesting, and foraging habitat at risk with respect to stand-replacing fire.

Effects Common to Both Action Alternatives

Both action alternatives would have the same effects on golden eagles, with alternative 2 thinning and treating more acres, but with the same potential effects from restoration activities. Direct effects would be from activities that cause disturbances (smoke, auditory, or visual) to golden eagles nesting or foraging within or adjacent to the project. Under alternative 2 or 3, there would be no direct adverse effects on nesting eagles as project design features would eliminate disturbance near known nesting sites. In golden eagle breeding areas, mechanical treatments within 500 to 1,000 feet of golden eagle nest trees or nest sites would only occur outside of the breeding season (January 1 to August 31), unless the nest is determined to be inactive by the District Biologist in coordination with AGFD and USFWS. Drift smoke from prescribed fire would be expected in most places; concentrations of smoke that might settle in an area for more than one or two nights when a female is on the nest could have adverse effects on

individuals. Prevailing southwest winds and the topography of the area typically act to lift smoke, carrying it away from ignition sites. Nests on cinder cones and other raised topographic features on the Mogollon Rim are not expected to have smoke settle in them long enough to cause measurable effects on eagles because of the air movement in these landscape-scaled features. Conversely, nests in areas occurring in small canyons or valleys may have dense smoke settle in nesting locations.

When smoke settles into low-lying areas, it typically does not last more than one or two nights. Limited smoke at nest locations would be expected to expose adult eagles to negligible effects as this would repeat an aspect of their evolutionary environment (Horton and Mannan 1988, Prather et al. 2008). However, on occasion dense smoke may settle into specific nest locations. Dense smoke settling into nest areas early in the season (March through June) could disturb brooding females. If the female is flushed long enough to affect incubation, this could result in loss of viability of the eggs. Dense smoke settling for multiple consecutive nights could affect the developing lungs of nestlings. Unlike mammals, damaged avian lungs do not repair themselves through time (Rombout et al. 1991). Causing the female to discontinue incubating eggs or affecting lung development of nestlings would result in long-term adverse effects. Outside of these examples, smoke settling in nest locations would typically be short-term and not likely to cause adverse effects.

Under alternatives 2 and 3, mechanical treatments, prescribed burning, road construction and decommissioning, hauling of wood products, and other restoration activities may cause visual or auditory disturbance to foraging golden eagles. This disturbance would be localized, of short duration and low intensity, and would not be expected to substantially interfere with normal feeding behavior. Up to 40,000 acres of prescribed burning and 45,000 acres of mechanical treatment would occur annually; however, these would be short-term effects and would be minimized due to activities being spatially and temporally separated. Additionally, prescribed burning effects would dissipate over time, as first entry burns usually consume accumulated surface fuels, raising crown bulk height and reducing crown bulk density. In maintenance or second entry burns in ponderosa pine, fuel loads would be significantly lower and produce low-severity effects with fewer emissions.

Indirect effects on the golden eagle include effects on eagle habitat, eagle prey species, or prey species habitat. There are no anticipated adverse effects on prey species or their habitats. Opening the canopy would provide improved visibility of and access to prey by golden eagles. Grassland and savanna treatments would maintain and improve foraging habitat on 36,340 acres of grassland and 17,590 acres of savanna habitat, improving prey species habitat by increasing availability of food for small mammals and resulting in an indirect beneficial effect.

Determination of Effect

Because of the design features included for both action alternatives to mitigate disturbance to eagles, the proposed treatments and activities **would not result in take** as defined in the Bald and Golden Eagle Protection Act for golden eagles.

Cumulative Effects

The cumulative effects analysis boundary is defined as the project area and a one-half mile buffer around the outside of the project boundary, and includes effects for a period of 25 years beginning with implementation of the Rim Country Project. Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating wolf habitat in Rim Country would be reduced in the short and long terms.

Other activities planned that may have similar effects include temporary disturbances caused by prescribed fire and thinning in adjacent projects, or effects on roosting habitat from utility infrastructure development and maintenance. These short-term effects added to similar effects from other activities were considered. Implementation of other fuel reduction and restoration activities could occur simultaneously; however, it is not anticipated that effects from those activities would combine with effects from the Rim Country Project to cause negative effects.

Alternative 3 would treat less acres overall proposing 528,850 acres of treatment (462,210) less than alternative 2 which would result in less forest and watershed restoration and providing less risk of severe wildfire effects.

American Peregrine Falcon

Alternative 1 – No Action

In grasslands, savannas, and meadows, tree encroachment and surface litter accumulation would continue, continuing to negatively affect some prey habitats for peregrine falcons. Stability of key ecosystem components such as species composition, forest structure, soil characteristics, and hydrologic function would be at moderate to high risk of loss in the event of a disturbance such as a high-severity wildfire. This alternative would result in the most stress on meadow and grassland habitats and thus would have the greatest negative contribution to potential grassland habitat.

Determination of Effect

Under the no action alternative, there would be **no direct or indirect effects on the American peregrine falcon**. There would be no change to the prey species base, and no change in falcon hunting patterns within associated forest structure.

Effects Common to Both Action Alternatives

Constructing and reconstructing roads along their original alignments, including temporary and relocated roads, would not have noticeable effects on the physical habitat features along the roads. Increased disturbance associated with the increased activity on the improved road conditions may decrease the habitat quality along the improved roads. Aquatic and other habitat restoration in alternatives 2 and 3 would improve habitat. There would be short-term disturbance to vegetation during implementation of restoration projects. However, restored vegetation would be expected within one year following restoration activities.

Decommissioning of roads in Alternatives 2 and 3 would improve the quality of the habitat in those areas where roads are decommissioned. The physical structure and features of habitat for falcons and their prey would be improved along the former road alignment, and disturbance along the roadway would largely be eliminated, thereby improving the quality of habitat in the long term.

Constructing temporary roads would disturb vegetation and reduce available habitat for peregrine prey. This may affect individuals but is expected to be short term, occurring only during project implementation. Temporary roads would be obliterated to eliminate use and vegetation would be restored over the long term.

Alternative 2 – Modified Proposed Action

Under the modified proposed action, no direct effects from mechanical treatments, temporary road construction, prescribed burning, or spring, riparian habitat, and ephemeral stream restoration is expected. There are four peregrine eyries (nest locations) within the project area. All four are associated with one pair of peregrines. These eyries are located on cliff ledges in a rugged canyon. No thinning treatments are proposed in these areas though they often overlook woodlands, riparian areas, or other habitats supporting avian prey species in abundance, which describes most of the Mogollon Rim and steeper canyons: a burn-

only treatment is planned. Smoke from burning operations would be expected to drain away from the nest location, reducing the potential for birds to be exposed to heavy concentrations of smoke. This area is also designated as a Mexican spotted owl protected activity center; protection measures developed for the owl would also protect peregrines breeding in this area as their breeding season overlaps with the owl.

Mechanical treatments prescribed burning, hauling of wood products, and other project activities may cause visual or auditory disturbance to foraging peregrine falcons. Approximately 40,000 acres of prescribed burning and 45,000 acres of mechanical treatment would occur annually; however, these are short-term effects and would be minimized due to activities being temporally and spatially separated. This disturbance would be localized, of short duration and low intensity, and may affect individual birds, but would not affect the overall distribution or reproduction of the species.

While peregrines do not nest or forage in ponderosa pine forest, active management in portions of the pine forest could potentially affect prey base habitat such as meadows, grasslands, and savannas, which are commonly encroached by pine trees as a result of fire exclusion. Restoring these habitats toward historic conditions and increasing water yield across the forest to improve marsh, pond, or lake habitat could increase prey base for peregrine falcons, resulting in an indirect beneficial effect.

Determination of Effect

Alternative 2 may affect individual peregrine falcons, but is not likely to cause a trend toward federal listing or loss of viability.

Alternative 3 – Focused Restoration Alternative

Alternative 3 treats fewer forest acres in Rim Country. The direct and indirect effects would be similar to alternative 2. Alternative 3 includes the same miles and acres of riparian and other habitat restoration, while reducing the total number of acres thinned and treated with prescribed burning. While short-term effects from disturbance would be lessened slightly in alternative 3, long term effects of risk of habitat degradation from stand-altering wildfire or insect infestations are greater.

Determination of Effect

Alternative 3 may affect individual peregrine falcons, but is **not likely to cause a trend toward federal listing or loss of viability**.

Cumulative Effects

The cumulative effects analysis area for peregrine falcons is grassland, savanna, and riparian habitat within the project area and within 0.5 mile outside the project boundary. The temporal boundary is 30 years to include the effects of 20 years of implementation with effects from treatments lasting 10 years of riparian benefits following implementation.

Under both action alternatives, there would be an additive indirect effect from activities that modify vegetation. Those projects where thinning and burning are implemented could affect the prey base on a short-term basis by affecting individuals of prey species, by disturbing or harming prey species' habitat with fire. However, projects would be implemented at different times and in different locations, cumulatively minimizing disturbances to the prey base.

Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating wolf habitat in Rim Country would be reduced in the short and long terms.

Other past, present, and ongoing projects have implemented thinning and prescribed burning (39,000 acres) in grasslands, which would cumulatively improve habitats for peregrine prey species in the long term.

Western Burrowing Owl

There are no documented nesting burrowing owls on the project area; however, potential nesting habitat does exist.

Alternative 1 – No Action

Tree encroachment and canopy development of existing trees would largely continue under alternative 1. Denser forest conditions would produce lower values in understory biomass (pounds per acre). Understory biomass would continue to decline over the next 40 years under alternative 1. This in turn would lead to less available habitat for prairie dogs and, consequently, burrowing owls. Vegetation would continue to grow and fuel would continue to accumulate, continuing to have negative effects on prairie dog habitat and potential habitat for western burrowing owls. Acres of grassland in Fire Regime Condition Class 1 would decrease in the absence of any type of treatment, as woody species continue to encroach and species composition shifts in favor of less fire-adapted species. Grasslands in the project area are at high risk of losing key ecosystem components such as species composition, forest structure, soil characteristics, and hydrologic function in the event of high-severity fire. High fire severity potential would persist, and a large crown wildfire event would have the potential to affect many individuals.

This alternative would result in the most stress on meadow and grassland habitats and thus would have the greatest negative effects on potential western burrowing owl habitat.

Alternative 2 – Modified Proposed Action

Alternative 2 would restore about 54,000 acres of historic grassland and savannas. Indirect effects on burrowing owls would include effects on owl habitat, owl prey species, or prey species habitat. Active management in some areas of ponderosa pine forest could potentially affect their habitat (for example, meadows and grasslands are commonly encroached by pine trees as a result of fire exclusion). Restoring these habitats toward historic conditions could increase potential nesting and foraging habitat for western burrowing owls.

Meadow restoration treatments would improve and increase available habitat for prairie dogs, which would subsequently provide nesting habitat for burrowing owls. Alternative 2 would increase available habitat for prairie dogs with 54,000 acres of grassland, meadow, and savanna restoration treatments. Grassland treatments would not lead to a change in the percent of area with the potential for crown fire. Prescribed burning would result in the removal of cover and food; however, it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats for insects and small mammals, increasing food sources and resulting in an indirect beneficial effect for burrowing owls.

Determination of Effect

Alternative 2 **may affect individual** burrowing owls but would improve potential future habitat for the species. **It is not likely to cause a trend toward Federal listing or loss of viability.**

Alternative 3 – Focused Alternative

Direct, indirect, and cumulative effects from alternative 3 would be the same as those from alternative 2.

Determination of Effect

Alternative 3 **may affect individual** to burrowing owls but would improve potential future habitat for the species. **It is not likely to cause a trend toward Federal listing or loss of viability.**

Cumulative Effects

The cumulative effects analysis area for burrowing owls encompasses the project area and the associated prairie dog complexes. The temporal boundary is 30 years to include 20 years of implementation and 10 years of benefits from treatments.

Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating habitat in Rim Country would be reduced in the short and long terms.

Cumulative activities such as implementing the Travel Management Rule are likely to decrease motorized use in grasslands, thus decreasing effects on prairie dog populations. This, combined with forest thinning and prescribed burning activities, could open up more habitat and increase grassland habitat connectivity. Short-term and localized effects from mechanical thinning and prescribed burning would result in disturbance, and the potential for collapse of burrows and displacement of prairie dogs. This effect may be cumulative with short-term effects from localized dispersed camping, wildfire, and wildfire suppression activities to temporarily displace prairie dog populations (and potentially burrowing owls) in limited areas.

Thinning 36,340 acres of grassland would cumulatively add to treatment acres from this project to reduce tree densities in grasslands and connect open corridors across the project area, providing additional potential future habitat for burrowing owls. Alternative 3 would treat less acres overall proposing 528,850 acres of treatment (462,210) less than alternative 2, which would result in less forest and watershed restoration and providing less risk of severe wildfire effects.

Navajo Mogollon Vole

Alternative 1 – No Action

In alternative 1, grasslands, meadows, and savannahs would not be rehabilitated. At the landscape scale, there would be no benefits to vole habitat. Favorable habitat would decrease over time as conifers encroach into meadows and canopy closure increases. Acres of grassland would decrease in the absence of any type of treatment, as woody species continue to encroach and species composition shifts in favor of less fire-adapted species. Acres of ponderosa pine with the likelihood of high-severity wildfire would continue to increase. Ponderosa pine in the project area would be at a high risk of losing key ecosystem components, should there be a disturbance event such as fire or extended drought (fire ecology and air quality specialist reports). Ponderosa pine in the project area is at high risk of losing key ecosystem components such as species composition, forest structure, soil characteristics, and hydrologic function in the event of high-severity fire.

Wildfire modeling in the ponderosa pine habitat type by alternative show that of the 553,137 acres of ponderosa pine habitat type in the project area, 407,189 acres (81 percent) have the potential to experience high-severity wildfire under alternative 1. Crown fire potential in ponderosa pine habitat from alternative 1 could occur in 480,996 acres (87 percent) of this habitat type, affecting the surrounding grasslands, meadows, and savannahs.

Vegetation would continue to grow and fuel would continue to accumulate, continuing to have negative effects on vole habitat.

Determination of Effect

Alternative 1 would have **no effect on the Navajo Mogollon voles**, and is not likely to cause a trend toward federal listing or loss of viability.

Alternative 2 – Modified Proposed Action

Under alternative 2, thinning and prescribed burning activities might disturb individual voles, resulting in direct adverse effects. Prescribed burning would result in the removal of cover and food; however, it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. Such activities would occur across the project area at different times; thereby reducing effects on this species. In addition, the effect would be short-term and would have no effect on the population viability of voles. However, fire exclusion has resulted in uncharacteristically dense forests and meadow and grassland encroachment. Forest treatments can indirectly affect potential vole habitat by restoring meadows and reducing uncharacteristic tree densities and patterns in ponderosa pine forest. Restoring meadows and creating openings in the forest would increase potential understory development, including bunch grasses and other plants with C3 photosynthetic pathways, providing preferred food sources for voles.

In addition to grassland, savannah, and meadow restoration treatments, alternative 2 calls for a diverse range of mechanical treatments where canopy openness would vary from 10 to 90 percent, depending on localized site conditions. Opening the canopy would provide both habitat connectivity and habitat stepping stones, facilitating landscape movements of dispersing voles. Reducing stand density could potentially reverse the declining trend in C3 plants and increase habitat quality for Mogollon voles. Prescribed fire and mechanical treatments would improve the stability of key ecosystem elements such as species composition, forest structure, soils, and hydrologic function. Moving these habitats toward historic conditions could increase potential habitat quality and quantity and reduce the risk of uncharacteristic, high-severity wildfire. The reduction of ponderosa pine basal area, increased growth in the understory vegetation on the forest floor, and increases in snags would result in indirect beneficial effects on the vole.

Under alternative 2, as many as 250 miles of closed roads could be decommissioned. Roads often encourage removal of snags as hazard trees and provide easy access for fuelwood cutting, potentially reducing snags along roadways. Ganey (personal communications 2012) found an inverse relationship between snags and roads, so the proposed decommissioning of roads means more snags would be available in the future within vole habitat.

Fence design would allow access to small mammals. In addition, about 10 miles of road segments would be moved out of drainage bottoms, further enhancing vole habitat.

Determination of Effects

Alternative 2 **may affect the Navajo Mogollon vole**, but is not likely to cause a trend toward Federal listing or loss of viability.

Alternative 3 – Focused Alternative

The effects from this alternative would be similar to those from alternative 2. The same grassland restoration acres are proposed. Fewer acres are proposed for thinning and burning and 15,000 fewer acres of savannah treatments are proposed.

Determination of Effects

Alternative 3 **may affect the Navajo Mogollon vole**, but is not likely to cause a trend toward Federal listing or loss of viability.

Cumulative Effects

The cumulative effects analysis area for Navajo Mogollon voles is the project area. The temporal boundary is 30 years to include 20 years of implementation and 10 years of benefits from treatments.

Short-term effects added to similar effects from nearby projects were considered. Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating habitat in Rim Country would be reduced in the short and long terms. Implementation of other project activities could occur simultaneously; however, it is not anticipated to cause cumulative negative effects. Both action alternatives would move these habitats toward historic conditions and could increase potential habitat quality and quantity, reducing the risk of uncharacteristic, high-severity wildfire. This positive effect, combined with similar effects from activities such as the Travel Management Rule efforts, may decrease the frequency of disturbance on the majority of potential breeding sites, slightly counteracting the effects from utility line and road construction and maintenance, and short-term disturbances from vegetation management and prescribed fire.

Livestock are managed in systems designed to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative effects from their grazing. However, wild ungulates would continue to reduce vegetative understory and affect plant composition. Cumulative activities such as the Travel Management Rule are likely to decrease motorized use in grasslands and meadows, thus decreasing effects on vole habitat. This, combined with forest restoration activities, could open up more habitats or provide more contiguous swaths of grassland habitat key to supporting thriving vole populations.

Alternative 3 would treat less acres overall proposing 528,850 acres of treatment (462,210) less than alternative 2, which would result in less forest and watershed restoration and providing less risk of severe wildfire effects.

Western Red Bat

Alternative 1 – No Action

With no treatments for the Rim Country Project, habitat quality would deteriorate for this species as overtopping ponderosa pine would lead to a decline in Gambel oak roosting habitat. The high fire hazard potential would persist, and a large, uncharacteristically severe wildfire event would have the potential to affect individuals. Acres of grassland in Fire Regime Condition Class 1 would decrease in the absence of treatments beyond the 13,440 acres of grassland thinning and burning resulting from current and reasonably foreseeable projects (see cumulative effects to all species section). At the landscape scale, woody species would continue to encroach into openings and species composition would shift in favor of less fire-adapted species. Ponderosa pine cover types in the project area would be at a high risk of losing key ecosystem components, should there be a large-scale disturbance event. In the event of high-severity fire, these key ecosystem components include species composition, forest structure, soil characteristics, and hydrologic function. High fire severity potential would persist, and a large crown wildfire event would have the potential to affect many individuals.

Wildfire modeling in the ponderosa pine habitat type by alternative show that of the 553,137 acres of ponderosa pine habitat type in the project area, 407,189 acres (81 percent) have the potential to experience high-severity wildfire under alternative 1. Crown fire potential in ponderosa pine habitat from alternative 1 could occur in 480,996 acres (87 percent) of this habitat type, affecting the surrounding grasslands, meadows, and savannahs.

Although habitat would be provided for this species, most of the forested area within the project area is in a moderately closed or closed canopy condition. Favorable habitat would decrease over time as conifers encroach into meadows and canopy closure increases, resulting in indirect adverse effects. Under alternative 1, limited acres of grasslands and forest opening would be restored, thus reducing foraging habitat for red bats. Gambel oak would continue to be overtopped by pine. Loss of mid- to large-diameter classes of oak from competition and from crown fire could reduce day roosts for red bats.

Water quality and riparian conditions would be adversely affected on a wide-scale basis, resulting in indirect adverse effects. Under alternative 1, there would no restoration of springs and no restoration of ephemeral channels. These areas would continue to exhibit downward trends in functional condition or remain in static condition for the foreseeable future, resulting in degradation of potential habitat for western red bats.

Determination of Effect

Alternative 1 may affect western red bats, but is not likely to cause a trend toward Federal listing or loss of viability.

Alternative 2 – Modified Proposed Action

Prescribed burning in riparian areas would be coordinated with wildlife biologists to determine presence of federally listed or sensitive species (plants or animals) as well as mitigations needed for rare or sensitive species in/near the work areas. Thinning and prescribed burning activities could potentially disturb red bats if they are roosting in trees and caves, or hibernating among leaf litter within the ponderosa pine treated area. Prescribed burning occurring when bats are rearing young (April–July) or in deep hibernation (mid-winter) could have negative effects on local populations. However, most prescribed burning would occur in the spring and fall, and burn plans within 0.5 mile of known roosts or hibernacula would be designed to limit smoke at critical times (April–July and mid-winter).

Prescribed burning might result in the loss of snags and Gambel oak which could affect roosting bats. However, mitigation including managing for retention of all snags 18 inches in diameter and ignition techniques would reduce the losses of these forest components. Recruitment snags would be provided by retaining trees 18 inches in diameter and greater with dead tops and lightning damage. Selective thinning designed to release oak from competition would help create and retain mid- to large-sized oak. The modified proposed action is expected to result in a slight short-term decrease in snags followed by an increase over the long term. This short-term loss of snags is not expected to affect the overall distribution of western red bats on the forest.

Alternative 2 calls for a diverse range of mechanical treatments that would vary from 10 to 90 percent open depending on site conditions. Prescribed burning after mechanical treatments would result in the removal of cover and food. However, it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. The reduction of dense forest canopy and increased growth in the herbaceous vegetation on the forest floor would result in indirect beneficial effects on bats. Forest conditions after treatment would improve bat habitat within the project area by increasing diversity and the density of understory vegetation, which provides habitat for prey populations, as many invertebrates are tied to specific understory plant species. Indirect benefits could potentially result from restoring meadows encroached by pine trees, and reducing uncharacteristic tree densities and patterns in the ponderosa pine forest that resulted from fire exclusion. These efforts would aid in restoring openings and edge habitat within the forest and improving understory vegetation that would benefit western red bats and their prey. Moving these habitats toward historic conditions would also increase the resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire.

Under the modified proposed action, spring, seep, and ephemeral channel restoration would improve riparian vegetation, increasing availability of food for bats over the long term, resulting in indirect beneficial effects.

Determination of Effect

Alternative 2 **may affect the western red bat**, but is not likely to cause a trend toward Federal listing or loss of viability.

Alternative 3 – Focused Alternative

The direct, indirect, and cumulative effects on the western red bat from alternative 3 would be the same as from alternative 2.

Determination of Effect

Alternative 3 **may affect the western red bat**, but is not likely to cause a trend toward Federal listing or loss of viability.

Cumulative Effects

The cumulative effects analysis area for western red bats is the project area. The temporal boundary is 30 years to include 20 years of implementation and 10 years of benefits from treatments.

Short-term disturbance to bats would occur during thinning, hauling, and prescribed burning activities and may cause disturbance in nearby areas for the duration of the activity. These short-term effects added to similar effects from other past, present, and reasonably foreseeable projects were considered.

Implementation of other fuel reduction activities could occur simultaneously; however, it is not anticipated that effects from these projects would combine with effects from the Rim Country Project activities to cause a negative effect. Ungulate grazing within the project area would reduce understory vegetation, which would reduce plant availability to adult insects, a primary food source. Generally, grazing systems are managed on a rotation to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative effects. However, wild ungulates would continue to reduce vegetative understory and affect plant composition in meadows and around waters.

Alternative 3 would treat less acres overall proposing 528,850 acres of treatment (462,210) less than alternative 2, which would result in less forest and watershed restoration and providing less risk of severe wildfire effects.

Pale Townsend's Big-eared bat

Alternative 1 – No Action

With no treatments for the Rim Country Project, habitat quality would deteriorate for this species as overtopping ponderosa pine would lead to a decline in roosting habitat. As tree densities increase, there would be less edge habitat, thereby reducing foraging opportunities. Seeps and springs would not be restored, which would continue to reduce the availability of riparian-associated host plants for noctuid moths on which the bat preys. High fire severity potential would persist, and a large, uncharacteristically severe wildfire event would have the potential to affect many individuals. Wildfire modeling in the ponderosa pine habitat type by alternative show that of the 553,137 acres of ponderosa pine habitat type in the project area, 407,189 acres (81 percent) have the potential to experience high-severity wildfire under alternative 1. Crown fire potential in ponderosa pine habitat from alternative 1 could occur in 480,996 acres (87 percent) of this habitat type, affecting the surrounding grasslands, meadows, and savannahs.

Fire intensity would continue to increase over time as vegetation would continue to grow and fuel would continue to accumulate, continuing to have negative effects on bat habitat. Acres of grassland would

decrease in the absence of any type of treatment, as woody species continue to encroach and species composition shifts in favor of less fire-adapted species. Ponderosa pine cover types in the project area would be at a high risk of losing key ecosystem components, should there be a disturbance event, such as fire or extended drought (fire ecology and air quality specialist reports). Key ecosystem components such as species composition, forest structure, soil characteristics and hydrologic function would be at a high risk of loss in the event of high-severity fire. High fire severity potential would persist, and a large crown wildfire event would have the potential to affect many individuals. Thirty-nine percent of the ponderosa pine and 12 percent of grassland habitat would support a crown fire. Marginal foraging habitat would still exist for this species; however, the high fire hazard potential would persist, and a large crown wildfire event could have the potential to affect individuals, resulting in indirect adverse effects.

Determination of Effect

Alternative 1 **may affect** pale Townsend's big-eared bats, but is not likely to cause a trend toward Federal listing or loss of viability.

Alternative 2 – Modified Proposed Action

Forest management treatments potentially benefiting bats and their prey include group selection (small groups of trees removed for regeneration of new age classes resulting in a mosaic of roosting habitat, and small to medium gaps for foraging) and single tree selection (individual trees of all size classes removed fairly uniformly). These treatments maintain diverse forest structure and roost trees, create gaps that enhance edge habitat, and provide diverse vegetation structure increasing herbaceous vegetation important for bats' insect prey (Taylor 2006).

There are caves within 300 feet of the project boundary. Coconino Land Management Plan guidelines recommend a 300-foot buffer around cave entrances, sinkhole rims and drainages leading to these features. This is a design feature for all known caves within the project area for alternatives 2 and 3. Design features were added to the project to reduce effects on bat roosts. This would eliminate the potential for damage to the cave from mechanized equipment or increased sedimentation and would eliminate disturbance to Townsend's bats if they are roosting in caves. This would eliminate the potential for damage to the cave from mechanized equipment or increased sedimentation, and would eliminate disturbance to Townsend's bats if they are roosting in caves.

Thinning and prescribed burning activities could potentially disturb Townsend's bats if they are roosting in trees within the ponderosa pine treated area. Prescribed burning occurring when bats are rearing young (April–July) or in deep hibernation (mid-winter) can have negative effects on local populations. However, most prescribed burning would occur in the spring and fall, and burning within 0.5 mile of known roosts or hibernacula or unsurveyed caves and mine shafts would be designed to limit smoke at critical times (April–May and mid-winter). Prescribed burning could also result in the loss of individual snags/hollow logs, which could affect roosting bats; however, mitigation including managing for retention of all snags 18 inches diameter and greater prior to prescribed burning would reduce the effects. The modified proposed action would be expected to result in a slight short-term increase in snags followed by a continued increase over the long term.

Prescribed burning would result in the removal of cover and food. However, it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. Indirect effects would result from vegetation modification activities such as thinning and prescribed burning. These activities would disturb or remove understory vegetation, subsequently reducing availability of insects. These effects would be short-term and would be minimized due to activities being temporally and spatially separated. In contrast, reducing canopy closure, removing trees in and at the edges of meadows, restoring meadows, and prescribed burning would encourage the development of understory vegetation, and increase the amount of edge which would increase availability of food for the bat over the long term. Increasing diversity and density of understory vegetation provides

habitat for prey populations. Many invertebrates are tied to specific understory plant species (Capinera 2010). Indirect benefits could potentially result from both restoring meadows encroached by pine trees and reducing uncharacteristic tree densities and patterns in the ponderosa pine forest that resulted from fire exclusion. These efforts would aid in restoring openings and edge habitat within the forest and improving understory vegetation that would benefit pale Townsend's big-eared bats and their prey. Moving these habitats toward historic conditions would also increase the resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire.

Under alternative 2, there are up to 250 miles of closed roads that could be decommissioned. Roads often encourage removal of snags as hazard trees and provide easy access for fuelwood cutting potentially reducing snags along roadways. Ganey (personal communications, 2012) found an inverse relationship between snags and roads, so the proposed decommissioning of roads means more snags would be available in the future within Townsend's big-eared bat habitat, providing more roosting structures.

Under the proposed action, spring, seep, and channel restoration would improve riparian vegetation, increasing availability of food for noctuids and therefore Townsend's big-eared bats over the long term, resulting in indirect beneficial effects.

Determination of Effect

Alternative 2 **may affect** pale Townsend's big-eared bats, but is not likely to cause a trend toward Federal listing or loss of viability.

Alternative 3 – Focused Alternative

The effects of alternative 3 would be the same as alternative 2. One documented cave roost is located within an AZGFD research site; however, these treatments are designed to provide tree groups up to 15 acres and can be designed to buffer cave locations as needed. Buffers are designed to eliminate potential sedimentation into the cave or damage from heavy machinery working over shallow passages. Alternative 3 has the same number of acres of grassland restoration treatments, while reducing savannah treatments by 15,000 acres.

Determination of Effect

Alternative 3 may affect pale Townsend's big-eared bats, but is not likely to cause a trend toward federal listing or loss of viability.

Cumulative Effects

The cumulative effects analysis area for pale Townsend's big-eared bats is the project area. The temporal boundary is 30 years to include 20 years of implementation and 10 years of benefits from treatments.

Short-term disturbance to bats would occur during thinning, hauling, and prescribed burning activities and may cause disturbance in nearby areas for the duration of the activity. These short-term effects added to similar effects from other past, present, and reasonably foreseeable projects were considered. Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating habitat in Rim Country would be reduced in the short and long terms.

Implementation of other fuel reduction project activities could occur simultaneously; however, they are not anticipated to combine with Rim Country activities to cause a negative effect. Ungulate grazing within the project area reduces understory vegetation, which reduces plant availability to adult insects, a primary food source. Generally, grazing systems are managed on a rotation to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative effects. However wild ungulates

would continue to reduce vegetative understory and affect plant composition in meadows and around waters. Implementation of the Travel Management Rule has reduced the number of roads near Townsend's big-eared bat roost locations.

Alternative 3 would treat less acres overall proposing 528,850 acres of treatment (462,210) less than alternative 2 which would result in less forest and watershed restoration and providing less risk of severe wildfire effects.

Allen's Lappet-browed Bat

Alternative 1 – No Action

Under alternative 1, only current and reasonably foreseeable projects would continue. Habitat would still exist for this species; however, the high fire hazard potential would persist, and a large, uncharacteristically severe wildfire event could have the potential to affect individuals and long-term suitability of habitat. Most of the forested area within the project area is in a moderately closed or closed canopy condition. Under alternative 1, grasslands and forest openings would not be restored, thus recruitment of large snags would not meet forest objectives in the long term. Large-diameter trees would not maintain the numbers and distribution that would support large-diameter snags distributed across forested areas. There would be reduced foraging habitat for Allen's lappet-browed bats as conifers encroach into meadows and canopy closure increases, resulting in indirect adverse effects. High basal area and trees per acre counts would decrease or stagnate growth of large trees. Active competition-induced mortality would increase, decreasing future recruitment of large snags and decreasing future maternity roost sites.

Determination of Effect

Alternative 1 may affect Allen's lappet-browed bats, but is not likely to cause a trend toward Federal listing or loss of viability.

Alternative 2 – Modified Proposed Action

Forest management treatments potentially benefiting bats and their prey include group selection (small groups of trees removed for regeneration of new age classes, which results in a mosaic of roosting habitat, and small to medium gaps for foraging) and single tree selection (individual trees of all size classes removed fairly uniformly). This would ensure a consistent source of large-diameter snags by maintaining recruitment of trees into larger size classes. These treatments would maintain diverse forest structure, including snags and gaps that enhance edge habitat, create diverse vegetation structure, and increase herbaceous vegetation important for bats' insect prey (Taylor 2006).

Thinning and prescribed burning activities could potentially disturb Allen's lappet-browed bats if they are roosting in trees within the ponderosa pine and pinyon juniper treated areas. Prescribed burning occurring when bats are rearing young (April–July) or in deep hibernation (mid-winter) can have negative effects on local populations. However, most prescribed burning would occur in the spring and fall and burning within 0.5 mile of known roosts/hibernacula or unsurveyed caves and mine shafts would be designed to limit smoke at critical times (April–May and mid-winter).

Prescribed burning could also result in the loss of individual snags which could affect roosting bats; however, mitigation including managing for retention of all snags 18 inches in diameter and greater would reduce this effect. Recruitment snags would be provided by retaining and growing more trees 18 inches in diameter and greater. Selection of trees with dead tops and lightning damage would contribute to potential habitat. The modified proposed action is expected to result in a slight short-term increase in snags followed by a continuing increase over the long term, with incidental loss of snags greater than 18 inches in diameter.

Prescribed burning would result in the removal of cover and food. However, it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. The reduction of dense forest canopy and increased growth in the herbaceous vegetation on the forest floor would result in indirect beneficial effects on bats. Forest conditions after treatment would improve bat habitat within the project area. Increasing diversity and density of understory vegetation provides habitat for prey populations. Many invertebrates are tied to specific understory plant species (Capinera 2010). Indirect benefits could potentially result from restoring meadows encroached by pine trees, as well as reducing uncharacteristic tree densities and patterns in the ponderosa pine forest resulting from fire exclusion. These efforts would aid in restoring openings and edge habitat within the forest and improving understory vegetation that would benefit Allen's lappet-browed bats and their prey. Moving these habitats toward historic conditions would also increase resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire.

Under alternative 2 there are up to 250 miles of closed roads that could be decommissioned. Roads often encourage removal of snags as hazard trees and provide easy access for fuelwood cutting potentially reducing snags along roadways. Ganey (personal communications, 2012) found an inverse relationship between snags and roads, so the proposed decommissioning of roads means more snags would be available in the future within Allen's lappet-browed bat habitat providing more roosting structures.

Under alternative 2, spring, seep, and channel restoration would improve riparian vegetation, increasing availability of food for bats over the long term, resulting in indirect beneficial effects.

Determination of Effect

Alternative 2 may affect Allen's lappet-browed bats, but is not likely to cause a trend toward Federal listing or loss of viability.

Alternative 3 – Focused Alternative

Alternative 3 treats fewer forest acres in Rim Country, but the direct and indirect effects would be similar to alternative 2. Alternative 3 includes the same miles and acres of riparian and other habitat restoration, while reducing the total number of acres thinned and treated with prescribed burning. The same grassland restoration acres are proposed as in alternative 2, but 15,000 fewer acres in forest openings such as meadows and savannahs are proposed. While short-term effects from disturbance would be slightly less to Allen's lappet-browed bats in alternative 3, the long-term effects on the risk of habitat degradation from stand-altering wildfire or insect infestations would be greater.

Determination of Effect

Alternative 3 **may affect** Allen's lappet-browed bats, but is not likely to cause a trend toward federal listing or loss of viability.

Cumulative Effects

The cumulative effects analysis area for Allen's lappet-browed bats is the project area. The temporal boundary is 30 years to include 20 years of implementation and 10 years of benefits from treatments.

Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating habitat in Rim Country would be reduced in the short and long terms.

The alternatives would be expected to result in a slight short-term increase in snags (greater than 12 inches diameter) followed by a continued increase over the long term of large snags (greater than 18

inches diameter). These short-term effects added to similar effects from other past, present, and reasonably foreseeable projects were considered.

Implementation of other fuel reduction and restoration activities could occur simultaneously; however, it is not anticipated that these effects would be additive to cause negative effects. Other fuel reduction and restoration projects might result in decreased large snags (greater than 18 inches in diameter) into the future. However, decreasing the potential for large-scale wildfires, and designing projects to increase tree growth for more large trees and, consequently, more recruitment snags, would improve the ability of tree roosting bats to locate roost sites across the landscape.

Prescribed burning produces low-severity burns that would reduce surface fuels and cause periodic loss of snags. Other activities such as high-severity wildfire, construction and maintenance of utility corridors, management of snags along forest roads, and private land development would also reduce the number of snags available for roosting in the long term. Large snags would be preserved whenever possible and design features to maintain and, where possible, develop snags on the landscape are incorporated into all projects. Although individual trees may be lost, large snags would be maintained and developed across the landscape to provide roosting habitat for Allen's lappet-browed bats.

Ungulate grazing within the project area reduces understory vegetation, which reduces plant availability to adult insects, a primary food source. Generally grazing systems are managed on a rotation to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative effects. However, wild ungulates would continue to reduce vegetative understory and affect plant composition in meadows and around water.

Alternative 3 would treat less acres overall proposing 528,850 acres of treatment (462,210) less than alternative 2, which would result in less forest and watershed restoration and providing less risk of severe wildfire effects.

Spotted Bat

Alternative 1 – No Action

Under alternative 1, only current and reasonably foreseeable projects would continue, as discussed in the cumulative effects to all species section. However, the high fire hazard potential would persist, and a large, uncharacteristically severe wildfire event would have the potential to affect individuals. Ponderosa pine forest in the project area would be at a high risk of losing key ecosystem components, should there be a disturbance event such as fire or extended drought (fire ecology and air quality specialist reports). Key ecosystem components in ponderosa pine forest include species composition, forest structure, soil characteristics, and hydrologic function. High fire severity potential would persist, and a large crown wildfire event would have the potential to affect many individuals. Although habitat would be provided for this species, most of the forested area within the project area is in a moderately closed or closed canopy condition. Under alternative 1, grasslands and forest openings would not be restored, thus there would be no benefits to bats. Favorable habitat would decrease over time as conifers encroach into meadows and canopy closure increases, resulting in indirect adverse effects. Wildfire modeling in the ponderosa pine habitat type by alternative show that of the 553,137 acres of ponderosa pine habitat type, 407,189 acres (81 percent) have the potential to experience high-severity wildfire under alternative 1. Crown fire potential in ponderosa pine habitat from alternative 1 could occur in 480,996 acres (87 percent) of this habitat type.

Determination of Effect

Alternative 1 **may affect** spotted bats, but is not likely to cause a trend toward Federal listing or loss of viability.

Alternative 2 – Modified Proposed Action

Forest management treatments potentially benefiting bats and their prey include group selection (small groups of trees removed for regeneration of new age classes resulting in a mosaic of roosting habitat, and small to medium gaps for foraging) and single tree selection (individual trees of all size classes removed fairly uniformly). These treatments maintain diverse forest structure and roost trees, create gaps that enhance edge habitat, and provide diverse vegetation structure increasing herbaceous vegetation important for bats' insect prey (Taylor 2006).

Under alternative 2, thinning and prescribed burning activities could potentially disturb spotted bats if they are roosting in rock crevices in the ponderosa pine treated area. Prescribed burning occurring when bats are rearing young (April–July) or in deep hibernation (mid-winter) could have negative effects on local populations. However, most prescribed burning would occur in the spring and fall and burning within 0.5 mile of caves, mines, or cliff habitats would be designed to limit smoke at critical times (April–May and mid-winter).

Prescribed burning would result in the removal of cover and food; however, it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. Indirect effects would result from vegetation modification activities such as thinning and prescribed burning. These activities would disturb or remove understory vegetation, subsequently reducing availability to insects. These effects would be short-term and would be minimized due to activities being temporally and spatially separated. In contrast, reducing canopy closure, removing trees in meadows, restoring meadows, and prescribed burning would encourage the development of understory vegetation, increasing availability of food for the bat over the long term.

Increasing the diversity and density of understory vegetation provides habitat for prey populations. Many lepidopterans are tied to specific understory plant species (Waltz and Covington 2004). Indirect benefits could potentially result from restoring meadows encroached by pine trees and reducing uncharacteristic tree densities and patterns in the ponderosa pine forest, a result of fire exclusion. These efforts would aid in restoring openings and edge habitat within the forest and improving understory vegetation that would benefit spotted bats and their prey. Moving these habitats toward historic conditions would also increase the resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire. Under the modified proposed action, spring, seep, and channel restoration would improve riparian vegetation, increasing availability of food for bats over the long term, resulting in indirect beneficial effects.

Determination of Effect

Alternative 2 **may affect** spotted bats, but is not likely to cause a trend toward Federal listing or loss of viability.

Alternative 3 – Focused Alternative

Alternative 3 treats fewer forest acres in Rim Country, but the direct and indirect effects would be similar to alternative 2. Alternative 3 includes the same miles and acres of riparian and other habitat restoration, while reducing the total number of acres thinned and treated with prescribed burning. The same grassland restoration acres are proposed as in alternative 2, but 15,000 fewer acres in forest openings such as meadows and savannahs are proposed. While short-term effects from disturbance would be slightly less to spotted bats in alternative 3, the long-term effects on the risk of habitat degradation from stand-altering wildfire or insect infestations would be greater.

Determination of Effect

Alternative 3 may affect spotted bats, but is not likely to cause a trend toward federal listing or loss of viability.

Cumulative Effects

The cumulative effects analysis area for spotted bat is the project area. The temporal boundary is 30 years to include 20 years of implementation and 10 years of benefits from treatments.

Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating habitat in Rim Country would be reduced in the short and long terms.

There could be potential short-term disturbance to potential foraging and roosting habitat with long-term benefits from the action alternatives. Short-term disturbance to bats would occur during thinning, hauling, and prescribed burning activities and may cause disturbance in nearby areas for the duration of the activity. These short-term effects, added to similar effects from other past, present, and reasonably foreseeable mechanical vegetation management and fuels reduction projects were considered. Implementation of these projects could occur simultaneously; however, it is not anticipated to accumulate to cause negative effects. Ungulate grazing in the project area reduces understory vegetation, which reduces plant availability to adult insects, a primary food source. Generally grazing systems are managed on a rotation to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative effects. However, wild ungulates would continue to reduce vegetative understory and affect plant composition in meadows and around water.

Alternative 3 would treat less acres overall proposing 528,850 acres of treatment (462,210) less than alternative 2, which would result in less forest and watershed restoration and providing less risk of severe wildfire effects.

Forest Service Management Indicator Species

Tonto National Forest Management Indicator Species

Rocky Mountain Elk

The Tonto National Forest estimated 283,200 acres of habitat occur on that forest for elk (USDA FS, 2005c). No treatment or limited treatments as per previous years of acres accomplished in this forest type would leave nearly 220,000 acres of this (77 percent) untreated. Alternative 1 would not result in an immediate change to the quantity or quality of habitat used by elk on national forests. Alternative 1 would continue to provide large patches of trees with higher basal area, canopy density, and interlocking crowns, thereby providing thermal and hiding cover for elk. However, forage production would be limited under the forest canopies. Pine encroachment into grassy openings and meadows would continue to limit foraging habitat for elk under alternative 1. Under alternative 1, the current unnatural stand densities would threaten the sustainability of elk habitat over time by limiting understory production and creating a higher risk for uncharacteristic, high-severity fire.

Alternatives 2 and 3 would not result in a type conversion of mixed conifer or Ponderosa pine habitat on the Tonto National Forest and therefore would have no effect to the population trend for elk. These alternatives would promote thinning trees and prescribed burning in ponderosa pine that would open the canopy and decrease fine fuels on the forest floor. The Tonto National Forest estimated 283,200 acres of habitat occur on that forest for elk (USDA FS, 2005c). The action alternatives could treat up to approximately 226,416 of this habitat on the Tonto National Forest, maintaining or improving the habitat quality of 80 percent of the available habitat on the Tonto National Forest. The result would be increased growth of herbaceous and shrub-level vegetation on these treated acres, which would provide increased forage in the long term. Reducing tree densities and ladder fuels would reduce available thermal and

hiding cover for elk. However, thermal protection for elk would continue to be available in areas maintained at higher basal area and canopy density.

Merriam's Turkey

The Tonto National Forest estimated 283,200 acres of habitat occur on that forest for turkey (USDA FS, 2005c). No treatment or limited treatments as per previous years of acres accomplished in this forest type would leave nearly 220,000 acres of this (77 percent) untreated. Alternative 1 would not result in an immediate change to the quantity or quality of habitat used by turkey on the national forests in the project area. Alternative 1 would continue to provide large patches of trees with a higher basal area, higher canopy density, and more interlocking crowns, thereby providing thermal and hiding cover for turkey. However, overstory suppression of oak, grass, and forb diversity and productivity would continue to limit foraging habitat for turkey in alternative 1. Tree encroachment into openings and meadows would also limit turkey foraging habitat. Late-seral ponderosa pine would continue to be threatened by unnatural stand densities, creating risk for uncharacteristic, high-severity fire.

Alternatives 2 and 3 would not result in a type conversion of mixed conifer or Ponderosa pine habitat on the Tonto National Forest and therefore would have no effect to the population trend for turkey. The Tonto National Forest estimated 283,200 acres of habitat occur on that forest for turkey (USDA FS 2005c). The action alternatives could treat up to approximately 226,416 of this habitat on the Tonto National Forest, maintaining or improving the habitat quality of 80 percent of the available habitat on the Tonto National Forest. The proposed treatments in alternatives 2 and 3 would protect nesting and roosting habitat. The proposed thinning and burning activities would create tree groups that are favored by turkeys and would also increase the understory production. Increasing the understory would also increase plant and invertebrate abundance.

Vegetation design features would protect most mast-producing Gambel oaks within the project area. Targeted removal of over-topping ponderosa pines would increase resiliency and persistence of large oaks. Design features also specifically address retaining medium to high canopy cover in stringers of large ponderosa pine trees in the pinyon-juniper transition zones. This is a habitat favored by roosting turkeys. Low- severity prescribed fire along ridges and slopes is expected to retain yellow pine and roosting cover above drainages in the pinyon-juniper transition zone. While turkeys are not grassland species, groups of large and old trees would be retained where they occur on mollic-integrate soils. The results of these treatments would be savanna conditions. This would add resilience to groups of large, old trees, potentially increasing turkey roost habitat. In addition, the open habitat conditions resulting from the grassland and savanna treatments would increase foraging habitat for adults and poults.

Abert's Squirrel

The Tonto National Forest estimated 283,200 acres of habitat occur on that forest for Abert's squirrels (USDA FS, 2005c). No treatment or limited treatments as per previous years of acres accomplished in this forest type would leave nearly 220,000 acres of this (77 percent) untreated. Alternative 1 would continue to provide large patches of trees with higher basal area, canopy density, and interlocking crowns, thereby providing wintering habitat for squirrels on national forests. However, alternative 1 would threaten the long-term viability of squirrels. Under alternative 1, the current unnatural stand densities would threaten the sustainability of squirrel habitat over time by reducing tree vigor and health, limiting pinecone production, and creating a risk for uncharacteristic, high-severity fire. Vigor and health of trees in the older age class categories are important for sustaining squirrel nesting habitat over time. Pinecone production is important for squirrel foraging and nutritional demands. Large-scale losses of squirrel habitat from uncharacteristically large, stand-replacing fire would affect squirrel populations across the project area.

Alternatives 2 and 3 would not result in a type conversion of mixed conifer or Ponderosa pine habitat on the Tonto National Forest and therefore would have no effect to the population trend for Abert's squirrels.

The Tonto National Forest estimated 283,200 acres of habitat occur on that forest for Abert's squirrels (USDA FS, 2005c). The action alternatives could treat up to approximately 226,416 of this habitat on the Tonto National Forest, maintaining or improving the habitat quality of 80 percent of the available habitat on the Tonto National Forest. With rare exceptions, alternatives 2 and 3 would not remove old growth trees, and there would be an emphasis on retention of large-diameter trees, which should benefit Abert's squirrels for nesting, winter cover, and cone production. Project design criteria include tree thinning using the goshawk guidelines. This should result in a mosaic of vegetation structural stages, interrupting canopy closure, and allowing more sunlight to reach the forest floor. The reduction in canopy connectedness would reduce safe travel routes for Abert's squirrels and expose them to higher rates of predation in treatments creating more higher degrees of openness. These treatments would also expose more of the forest floor to direct sunlight which could remove the microsite habitat for mycorrhizal fungi production, thereby reducing an important food source for squirrels. However, Dodd et al. (2006) postulated that up to 75 percent of a forested landscape could be treated and still provide suitable squirrel habitat, if treatments were applied as a mosaic of patches and areas of optimal habitat were retained. The alternatives are also designed to provide closed-canopy corridors to provide connectivity for squirrels and other species.

Alternatives 2 and 3 call for a diverse range of mechanical treatments to maintain forest habitat. Forest habitats would vary from 10 to 70 percent open, outside of grassland and savanna habitat, with variable basal area, trees per acre, and stand density index depending on site-specific conditions. Areas that would likely maintain a basal area and canopy cover high enough to support Abert's squirrels include Mexican spotted owl protected and recovery habitat, northern goshawk nest stands, other raptor nest sites, bald eagle roosts, buffers around caves and sinkholes, a portion of the older age class tree groups intended to support higher tree densities of mixed-age trees, and areas excluded from mechanical treatment such as wilderness. As such, the patches of forest within the mosaic proposed by alternatives 2 and 3 would vary in terms of Abert's squirrel habitat quality. A ratio of optimal to suboptimal patches that is skewed toward a more open condition would be less desirable to the squirrel and could lead to a short-term reduction in current squirrel populations. However, in the long term, post-treatment conditions would include tree growth and increased canopy connectedness, which should have a positive effect onto squirrel populations when viewed over longer time horizons.

Despite the proposed overall reduction in dense forest conditions, alternatives 2 and 3 would also provide for sustainable forests that include large, cone-bearing trees either as individual legacy trees or in groups, and clumps of mature and old-growth trees interspersed with patches suitable for fungi production. Canopy connectivity would be retained, but would no longer occur across so much of the landscape. In the long term, this should provide for more sustainable squirrel habitat over time because the risk of high-severity fire, and therefore long-term degradation or loss of squirrel habitat, would be significantly reduced (USDA FS 2005c). Landscape connectivity would be retained for canopy-dependent species.

Arizona Gray Squirrel

Alternative 1, no action, could lead to a decreased species trend if effects from high-severity wildfire is encountered in high-elevation riparian habitat across the project area.

Alternatives 2 and 3 would not result in a type conversion of riparian habitat on the Tonto National Forest and therefore would have no effect to the population trend for Arizona gray squirrels. The action alternatives would emphasize maintenance and restoration of healthy riparian ecosystems through conformance with LMP's riparian Desired Conditions. Management strategies should move degraded riparian vegetation toward good condition as soon as possible. Damage to riparian vegetation, stream banks, and channels should be prevented. Alternatives 2 and 3 would improve riparian habitat and would likely assist in keeping the population stable.

Common Black Hawk

Alternative 1, no action, could lead to a decreased species trend if effects from high-severity wildfire is encountered by riparian and cottonwood-willow vegetation type habitats across the project area.

Alternatives 2 and 3 propose 14,560 acres of riparian restoration. Improvement of stream function is proposed for 777 miles across the project area through the action alternatives. Black hawks could be disturbed by restoration activities; however, design features to protect raptor nests have been included in the project record. This should minimize disturbance to the common black hawk, though it is possible that disturbance from thinning implementation and short-term noise and smoke disturbance is possible during thinning and broadcast burning operations, potentially leading to loss of egg viability or injury or death to nestlings. The removal of any eggs or fledglings would not result in a measurable negative effect to the common black hawk population from any of the two action alternatives as the implementation of these acres would occur intermittently over space and time over the next 20 years. Long-term effects to the common black hawk population would be positive as a result of habitat restoration. Alternatives 2 and 3 would improve riparian and cottonwood-willow vegetation types and would likely assist in keeping the population stable.

Ash-throated Flycatcher

Alternative 1 could lead to a decreased species trend if high-severity wildfire is encountered in the pinyon-juniper vegetation type habitat across the project area.

Both action alternatives would include various levels of restoration implementation within pinyon-juniper. The alternatives could mechanically thin and burn 114,753 acres of pinyon-juniper. Most large trees would not be removed and pinyon-juniper woodlands would be managed for late-seral habitat, benefiting foraging and nesting habitat. Long-term benefits would include increasing understory development, managing for snag retention, and increasing habitat heterogeneity. Areas with currently dense conditions would be more open, leading to mixed long-term results for some species of birds. Unintentional take is expected to be minimized through the application of breeding season timing restrictions in northern goshawk PFAs, deferral areas, and other design features. Alternatives 2 and 3 would improve the pinyon-juniper vegetation type habitat and would likely keep the population stable.

Gray Vireo

Alternative 1 could lead to a decreased species trend if high-severity wildfire is encountered in the pinyon-juniper vegetation type habitat across the project area.

Both action alternatives would include various levels of restoration implementation within pinyon-juniper. The alternatives could mechanically thin and burn 114,753 acres of pinyon-juniper. Most large trees would not be removed and pinyon-juniper woodlands would be managed for late-seral habitat, benefiting foraging and nesting habitat. However, mechanical treatment and burning could destroy nests if these activities occur during breeding season. Short-term noise and smoke disturbance is possible during thinning and broadcast burning operations, potentially leading to loss of egg viability or injury or death to nestlings. Not all treatments would occur during the breeding season. Unintentional take of eggs or nestlings would not result in a measurable negative effect to the gray vireo population from both of the action alternatives. Alternatives 2 and 3 would improve the pinyon-juniper vegetation type habitat and would likely assist in keeping the gray vireo population stable.

Juniper Titmouse

Alternative 1 could lead to a decreased species trend if high-severity wildfire is encountered in the pinyon-juniper vegetation type habitat across the project area.

Both action alternatives would include various levels of restoration implementation within pinyon-juniper. The alternatives could mechanically thin and burn 114,753 acres of pinyon-juniper. Most large

trees would not be removed and pinyon-juniper woodlands would be managed for late-seral habitat, benefiting foraging and nesting habitat. However, mechanical treatment and burning could destroy nests if these activities occur during breeding season. Short-term noise and smoke disturbance is possible during thinning and broadcast burning operations, potentially leading to loss of egg viability or injury or death to nestlings. Not all treatments would occur during the breeding season. Unintentional take of eggs or nestlings would not result in a measurable negative effect to the juniper titmouse population from either of the action alternatives.

Hairy Woodpecker

Alternative 1 would increase the amount of late-seral forests in the long term. The risk of a large-scale wildfire is high. While fires promote recruitment of large snags, a study conducted locally, documented 40 percent of fire-killed snags falling within 7 years (Chambers and Mast 2005). Over 80 percent of ponderosa pine snags created by high-severity fire fell within 10 years after a fire (Chambers personal communications 2008, Mast personal communications 2008). In addition, patches that burn with high-severity in today's stand-replacing fires can reach several hundred hectares in size. Hairy woodpeckers do not use interior portions of larger burned areas, restricting much of their foraging to the edge habitat. The uncharacteristically large fires of recent years are less valuable to hairy woodpeckers than the smaller overstory-removing fires that occurred historically (USDA FS 2005c).

Both action alternatives are designed to restore ponderosa pine forests closer to the natural range of variation. Live conifer trees with the potential to provide nesting habitat cavities such as dead-top trees and lightning struck trees would also be favored for retention. Prescribed fires would be designed to maintain desired forest structure, tree densities, snag densities, and coarse woody debris levels. Using the northern goshawk guidelines to direct management activities should have a positive effect on the species, as these prescriptions would result in forest structure that more closely resembles historic forests than those present today, including large trees and an abundance of snags (USDA FS 2005c).

Northern Goshawk

In alternative 1, the quality of the habitat would deteriorate as canopies close tree densities increase, and understory production decreases. Closed canopies associated with higher tree densities would not allow sunlight and water to reach the forest floor for understory vegetation to grow, or provide habitat for prey species including vegetative cover, nesting substrates, seeds and fruits, grasses, forbs, and shrubs, as evidenced by the declining index of biomass production. In the long term, understory species richness would decline, reducing food and cover for prey species. Increased tree densities would increase competition among trees. Tree growth would decrease or stagnate and tree health decline due to competition for limited resources and space. Meanwhile, the lack of fire disturbance has led to increased tree density and fuel loads that increase the risk of uncharacteristically intense wildfire and drought-related mortality. When fires occur under current conditions, they tend to cause high tree mortality rates, including the large and old trees. These trees take longer to replace, moving the forest further from desired conditions, and increasing the time it would take to return to desired conditions. Another result of increased tree density is increased risk of insect and/or disease outbreak. Mortality created by these outbreaks also contributes to increased fuel loads and associated increase in the risk of uncharacteristically intense wildfire.

In alternatives 2 and 3, the large tree habitat structure required for northern goshawk nesting (for example, large, tall trees with large branches and adequate flight paths) would be more available across the landscape as the numbers of large trees increases, improving habitat for existing and future resident northern goshawks and potentially increasing recruitment into the population. Creating interspace between groups of trees would help support prey species. Trees used for nesting would be able to grow to larger size, retain more of their crowns, and live longer with less competition, thus providing higher quality habitat for nesting and foraging.

The quality of the late seral stage ponderosa pine habitat would be expected to improve as stand conditions move closer toward historic conditions with more open understories, less competition among trees, and healthier forest conditions. Increasing the understory response would improve the quality of northern goshawk foraging habitat by providing more food and cover for prey species. The improved development of understory could also increase the diversity and amount of prey species available to northern goshawks.

Alternatives 2 and 3 would produce the largest increase in the quantity of late seral ponderosa pine habitat as well as the most improvement in the quality of habitat for northern goshawks and their prey species as all elements move toward desired future conditions. Overall, alternatives 2 and 3 increase habitat quantity and improve habitat quality for northern goshawk and its prey species.

Northern Flicker

Alternative 1 could lead to a decreased species trend if high-severity wildfire is encountered in the pinyon-juniper vegetation type habitat across the project area.

Both action alternatives would include various levels of restoration implementation within pinyon-juniper. The alternatives could mechanically thin and burn 114,753 acres of pinyon-juniper. Most large trees would not be removed and pinyon-juniper woodlands would be managed for late-seral habitat, benefiting foraging and nesting habitat. However, mechanical treatment and burning could destroy nests if these activities occur during breeding season. Short-term noise and smoke disturbance is possible during thinning and broadcast burning operations, potentially leading to loss of egg viability or injury or death to nestlings. Not all treatments would occur during the breeding season. Unintentional take of eggs or nestlings would not result in a measurable negative effect to the northern flicker population from both action alternatives. Alternatives 2 and 3 would improve the pinyon-juniper vegetation type habitat and would likely assist in keeping the northern flicker population stable.

Townsend's Solitaire

Alternative 1 could lead to a decreased species trend if high-severity wildfire is encountered in the pinyon-juniper vegetation type habitat across the project area.

Both action alternatives would include various levels of restoration implementation within pinyon-juniper. The alternatives could mechanically thin and burn 114,753 acres of pinyon-juniper. Most large trees would not be removed and pinyon-juniper woodlands would be managed for late-seral habitat, benefiting foraging and nesting habitat. However, mechanical treatment and burning could destroy nests if these activities occur during breeding season. Short-term noise and smoke disturbance is possible during thinning and broadcast burning operations, potentially leading to loss of egg viability or injury or death to nestlings. Not all treatments would occur during the breeding season. Unintentional take of eggs or nestlings would not result in a measurable negative effect to the Townsend's solitaire population from both of the action alternatives. Alternatives 2 and 3 would improve the pinyon-juniper vegetation type habitat and would likely assist in keeping the Townsend's solitaire population stable.

Violet-green Swallow

Alternative 1 would lead to a decreased species trend if high-severity wildfire is encountered in the ponderosa pine/snags vegetation type habitat across the project area.

Alternative 1 would not result in an immediate change to the quantity or quality of habitat used by violet-green swallows. Late-seral ponderosa pine would continue to be threatened by unnatural stand densities, creating risk for uncharacteristic, high-severity fire.

The proposed treatments in alternatives 2 and 3 would protect nesting habitat. The proposed thinning and burning activities would also create canopy openings, allowing sunlight to reach more tree boles and

increasing the prey base for swallows. Thinning and burning treatments are designed to return forest structure and composition to within the natural range of variation, which should benefit native wildlife species (Kalies et al. 2010). The vegetation design features for alternatives 2 and 3 require that snags be managed to meet or move toward land management plan requirements and to move toward desired conditions. Snags or hazard trees within a distance of twice their height from private land boundaries or along key roads may be felled. In all other areas, conifer snags greater than 12 inches in diameter would be maintained, with an emphasis on snags greater than 18 inches in diameter, except in cases of human health and safety. Live conifer trees with the potential to provide nesting habitat cavities, such as dead-top trees and lightning struck trees, would be favored for retention. Prescribed burns are designed to maintain desired forest structure, tree densities, snag densities, and coarse woody debris levels.

Western Bluebird

Alternative 1 would lead to a decreased species trend if high-severity wildfire is encountered in the ponderosa pine open vegetation type habitat across the project area.

Alternative 1 would not result in an immediate change to the quantity or quality of habitat used by western bluebirds. Late-seral ponderosa pine would continue to be threatened by unnatural stand densities, creating risk for uncharacteristic, high-severity fire.

The proposed treatments in alternatives 2 and 3 would protect nesting habitat. The proposed thinning and burning activities would also create canopy openings, allowing sunlight to reach more tree boles and increasing the prey base for bluebirds. Thinning and burning treatments are designed to return forest structure and composition to within the natural range of variation, which should benefit native wildlife species (Kalies et al. 2010). The vegetation design features for alternatives 2 and 3 require that snags be managed to meet or move toward land management plan requirements and to move toward desired conditions. Snags or hazard trees within a distance of twice their height from private land boundaries or along key roads may be felled. In all other areas, conifer snags greater than 12 inches in diameter would be maintained, with an emphasis on snags greater than 18 inches in diameter, except in cases of human health and safety. Live conifer trees with the potential to provide nesting habitat cavities, such as dead-top trees and lightning struck trees, would be favored for retention. Prescribed burns are designed to maintain desired forest structure, tree densities, snag densities, and coarse woody debris levels.

Western Wood Pewee

Alternative 1 would lead to a decreased species trend if effects from high-severity wildfire is encountered by forested areas adjacent to riparian vegetation type habitats across the project area.

Alternatives 2 and 3 propose 14,560 acres of riparian restoration. Improvement of stream function is proposed for 777 miles across the project area in both action alternatives. Restoration of approximately 991,060 acres of forested habitat could occur with alternative 2 and approximately 528,850 acres in alternative 3.

Western wood peewees could be disturbed by restoration activities. It is possible that disturbance from thinning implementation and short-term noise and smoke disturbance could occur during thinning and broadcast burning operations, potentially leading to loss of egg viability or injury or death to nestlings. The removal of any eggs or fledglings would not result in a measurable negative effect to the western wood peewee population from any of the two action alternatives as the implementation of these acres would occur intermittently over space and time over the next 20 years. Long-term effects to the peewee population would be positive as a result of habitat restoration. Alternatives 2 and 3 would improve areas adjacent to riparian vegetation habitats and would likely assist in keeping the population stable.

Cumulative Effects

Some management indicator species are much more mobile than others. Therefore, it is important to recognize habitat outside the project area as the affected environment for some animals. The cumulative effects analysis area varies by species (table 58). The analysis includes the combined effects from all activities within the area as evaluated for each alternative. For example, the Abert's squirrel typically does not travel far; they stay in ponderosa pine forest year-round instead of migrating to lower elevations for the winter. Therefore, its cumulative effects analysis area is the ponderosa pine habitat type within the project area. On the other hand, elk use much larger areas to mate, calve, graze, and overwinter, so the cumulative effects analysis area for elk includes habitat outside the project area.

Cumulative effects can be an integral part of the effects analysis for wildlife and are discussed for each species. The cumulative effects discussed have occurred since 2001 and are considered changes in existing condition. The temporal boundary is 30 years to include 20 years of implementation and 10 years of benefits from treatments.

Table 58. Cumulative effects analysis area by species

Cumulative Effects Analysis Area	Species	Reason for Selection
Within project area	Pygmy nuthatch, turkey, Abert's squirrel, hairy woodpecker, red-naped sapsucker, juniper titmouse, Grace's warbler, western bluebird	Abert's squirrel use is focused on the area around their nest trees. Birds may move to other areas, but their nesting habitat is the most limiting factor for these species.
Project area plus 0.25-mile buffer around project area	Northern goshawk	The 0.25-mile buffer takes into account potential disturbances from activities within the project area.
Game management unit	Elk, mule deer, pronghorn	These species have wider mobility; GMUs are designed to encompass herd movements.

Alternative 1

The cumulative effects from the treatments occurring in current and within the reasonably foreseeable future are listed in the cumulative effects for all alternatives. These projects would improve the habitats of MIS species in the long term. Movement corridors and savanna treatments incorporated into ponderosa pine on the National Forests would benefit pronghorn and elk by creating forage and movement corridors. Other projects' restoration treatments would have limited effects on MIS species in the short term, but should improve habitat in the long term.

Fuelwood gathering would affect MIS species by removing snags and logs needed for nesting or prey species. The proposed activities could benefit elk, pronghorn, northern goshawk, squirrel, and songbird species locally by creating openings to support browse and improve landscape permeability.

Recreation would cause localized decreases in MIS habitat quality due to the loss of understory vegetation (trampling, removal) associated with camping; disturbance from motorized use and hikers. This would cause disturbance and displacement of MIS spatially and temporally, although many species have likely acclimated to areas with regular use. Species selected for riparian habitat such as the common black hawk and Arizona gray squirrel would continue to experience disturbance from recreation.

Right-of-way maintenance would benefit species that use open habitat like pronghorn, elk, and turkey by keeping liner strips of grassland open across the forest. These areas could also support prey species for northern goshawks. Right-of-way maintenance can also remove snags, logs, shrubs, and large trees, negatively affecting species tied to these habitat features such as the pygmy nuthatch, hairy woodpecker, western bluebird, northern flicker, and mule deer.

Development on private lands, particularly in the grassland and savanna habitats, would reduce habitat quantity and quality and affect movement corridors for pronghorn and elk.

Alternatives 2 and 3

The planned thinning and burning of ponderosa pine and mixed conifer habitat would help reduce small tree densities and help move habitat toward historical stand structures. These treatments would have the same benefits discussed in alternative 1, but when added to the additional treatments in the alternatives, would provide for improvement across the landscape. These treatments would affect the Mexican spotted owl, northern goshawk, Pygmy nuthatch, Rocky Mountain elk, Merriam's turkey, Abert's squirrel, Violet-green swallow, Hairy woodpecker, Western bluebird, and Western wood peewee by improving their habitats in the long term. These species' forestwide habitat trends would be improved by thinning projects that retain and enhance the large tree component within the ponderosa pine forest and that help create and retain large snags.

The 36,340 acres of grassland restoration, 17,600 acres of ponderosa pine savanna treatments, and 6,760 acres of meadow treatments would benefit pronghorn and elk by creating forage and corridors for movement between areas.

Treatment is possible on up to 115,000 acres of pinyon-juniper habitat. Design features would preserve older trees in this habitat type so effects from treatments to these MIS populations (ash-throated flycatcher, gray vireo, juniper titmouse, northern flicker and Townsend's solitaire) are expected to be minimal.

Fuelwood gathering and travel management requirements together help determine where the public can legally collect fuelwood. Since off road travel is only allowed in fuelwood areas, this would limit how far the public can travel to collect fuelwood. This would likely leave more dead and down woody material in areas farther from roads. There would likely be less dead woody material available within fuelwood areas closer to roads. This could prevent achieving land management plan requirements for snags, logs, and dead and down woody material near some roads. This would also limit how much fuelwood is removed away from roads and increase fuelwood removal along roads. Proposed treatments should help limit the amount of area not meeting forest requirements. This would affect the northern goshawk, pygmy nuthatch, hairy woodpecker, biolett-green swallow, northern flicker, and juniper titmouse by removing snags that are needed for nesting or prey species.

The effects on MIS from ongoing and foreseeable activities, along with the proposed activities in alternatives 2 and 3, are as follows: For all of the MIS species, the cumulative effects from these projects **would not adversely change the predicted forestwide habitat and population trends.**

Migratory Birds and Important Bird Areas

In the Mogollon Rim Snowmelt Draw Important Bird Area, the Rim Country Project would affect approximately 45,673 acres of ponderosa pine, aspen, pinyon-juniper, grasslands and savannas, ephemeral streams, and spring habitats. Mexican spotted owl protected, recovery, and critical habitats occur in the Important Bird Area. All design features associated with these habitat types would be followed as discussed in previous sections of the FEIS.

Effects of the Proposed Activities on Migratory Birds

Currently, many migratory birds depend on habitats or habitat elements related to canopy openings, snags, and early seral conditions. Existing closed canopy forests limit or eliminate many of the necessary habitat components needed by these species, such as understory development sufficient to support abundant seeds, arthropods, and cover. The desired condition of closed canopy tree groups interspersed with open rooting space that supports herbaceous vegetation would provide key habitat components for these species of status as well as species adapted to closed-canopy forests. The ability to grow and maintain large trees would provide consistent development of future snags. Table 59 summarizes the long-term effects on migratory bird habitats.

Table 59. Long-term effects on migratory bird habitats from alternatives 2 and 3

Species	Habitat Links	Long-Term Effect to Habitat
Northern Goshawk	Late-seral PIPO ¹ /Prey Habitat	Improved
Flammulated Owl	PIPO/openings/insects/snags	Improved
Cordilleran Flycatcher	PIPO/insects/ oak/dense forest	Mixed
Grace's Warbler	PIPO/openings/insects/	Improved
Olive Warbler	PIPO/openings/insects/	Improved
Lewis's Woodpecker	PIPO/openings/insects/snags	Improved
Purple Martin	PIPO/openings/insects/snags	Improved
Cassin's Finch	PIPO/openings/seeds	Improved
Common Nighthawk	PIPO/openings/insects/	Improved
Mexican Whip-poor-will	PIPO/openings/insects/	Improved
Olive-sided Flycatcher	mixed conifer/openings/insects/snags	Improved
Evening Grosbeak	mixed conifer/openings/seeds	Improved
Red-faced Warbler	mixed conifer/oak/willow/insects/	Improved
Band-tailed Pigeons	mixed conifer/oak/willow/seeds/	Improved
Red-naped sapsucker	Aspen	Improved
Black-chinned Sparrow	Interior Chaparral	Mixed
Gray Vireo	Pinyon-juniper	Improved
Pinyon Jay	Pinyon-juniper	Improved
Juniper titmouse	Pinyon-juniper	Mixed
Black-throated Gray Warbler	Pinyon-juniper	Improved
Gray Flycatcher	Pinyon-juniper	Improved
Swainson's Hawk	Open/Grassland	Improved
Ferruginous Hawk	Open/Grassland	Improved
Burrowing Owl (western)	Open/Grassland	Improved
Grasshopper Sparrow	Open/Grassland	Improved
Bendire's Thrasher	Open/Grassland	Improved
Chestnut-collared Longspur	Semidesert Grassland	Improved
Lark Bunting	Semidesert Grassland, Desert Communities	Improved
Common Black-Hawk	Cottonwood/willow/riparian forest.	Improved
Bell's Vireo	Cottonwood Willow Riparian Forest	Improved
Elf Owl	Cottonwood Willow Riparian Forest	Improved
Lucy's Warbler	Cottonwood Willow Riparian Forest	Improved
Yellow Warbler	Cottonwood Willow Riparian Forest; Mixed Deciduous Riparian Forest	Improved
Lincoln's Sparrow	Montane Willow Riparian Forest (breeding)	Improved
MacGillivray's Warbler	Montane Willow Riparian Forest, Aspen and Maple, Mixed Conifer	Improved
Brewer's Blackbird	Wetlands, Montane/Subalpine Grasslands, Montane Willow Riparian Forest	Improved
Wood Duck	Cottonwood Willow Riparian Forest	Improved
Phainopepla	Desert Communities	None
Savannah Sparrow	Open habitats project-wide	Improved

Important Bird Areas

Most of the major vegetation cover types within the Mogollon Rim Snowmelt Draw IBA would be affected by alternatives 2 and 3. The habitat of this IBA includes Ponderosa pine, white fir, Douglas fir, southwestern white pine, quaking aspen, and Gambel oak. Young plants of these canopy trees, plus canyon maple and New Mexico locust dominate the understory woody species. While most of the acres treated are within ponderosa pine and dry mixed conifer habitats, treatments would also occur in savannah, meadows, aspen, and pinyon juniper habitats. In addition, 53 miles of road decommissioning, restoration of six springs, and 7.5 miles of ephemeral stream channel restoration activities are proposed within the IBA in alternatives 2 and 3. Design features (appendix C) are included in the project to reduce effects on bird species.

Overall, treatment objectives are to help restore forests to their natural range of variation.

Project activities including road decommissioning and spring and stream channel restoration, would help restore the area to more natural conditions. This should improve habitat conditions for all bird species that use the project area. There could be some limited effects on the species due to activities that might occur during the breeding season. It is expected that the habitats for which the Important Bird Area was established would benefit from the proposed treatments.

Cumulative Effects on Migratory Birds

Because of their seasonal movement, the primary management concern for migratory birds is nesting habitat and, for bald eagles, winter roost sites and known nest sites. The cumulative effects analysis area for migratory birds is the project area. The effects from projects that have already been implemented were used to help describe current conditions of the project area and will not be discussed in this section. Ongoing and reasonably foreseeable activities are listed in the cumulative effects for all alternatives section. Cumulative effects discussed here include those that have occurred since 2001 and the effects of the Rim Country alternatives. The timeframe considered is approximately 20 years in the future, at which time the majority of the activities proposed would have been completed and the vegetation response to these actions would have occurred. For further analysis on cumulative effects to migratory birds see the terrestrial wildlife specialist report.

The temporal boundary is 30 years to include 20 years of implementation and 10 years of benefits from treatments. Watershed and forest health would increase with the combination of other projects occurring in Rim Country such as the CC Cragin Watershed Restoration Project (on the Mogollon Rim Ranger District) and Flagstaff Watershed Protection Project (the San Francisco Peaks and Mormon Mountain), reopening or developing rock pits (Coconino and Apache-Sitgreaves), and other restoration work, such as in the Beaver Creek Rim Lakes and Larsen projects (Mogollon Rim). Cumulatively the risk of high-severity fire eliminating habitat in Rim Country would be reduced in the short and long terms.

Alternative 3 would treat fewer acres overall proposing 528,850 acres of treatment (462,210) less than alternative 2 which cumulatively would result in less forest and watershed restoration and providing less risk of severe wildfire effects.

Resulting forest structure from planned thinning and burning of 195,405 acres of ponderosa pine habitat outside of the Rim Country boundary would be habitat within the natural range of variation. In the long term, wildlife species are less likely to be adversely affected by treatments that result in habitat conditions consistent with those of their evolutionary past and so are expected to respond positively to the ongoing and proposed thinning projects (Kalies et al. 2010). These treatments would improve habitat for most birds species associated with the ponderosa pine cover type in the long term (for example, bark gleaners, woodpeckers, and flycatchers), but may negatively affect foliage gleaners in the short term (Patton and Gordon 1995, George et al. 2005). For further information about the cumulative effects to migratory birds from alternatives 2 and 3 see the terrestrial wildlife specialist report.

The proposed project would treat between 42,486 to 43,863 acres of habitat within the Important Bird Area. This would cumulatively improve habitat condition within a broader area of the Important Bird Area.

Seasonal restrictions would limit project implementation activities between March 1 and September 30 in northern goshawk nest areas and post-fledging family areas and within Mexican spotted owl protected activity centers, which would reduce the potential for loss of species in ponderosa pine habitat. Prescribed fire could also occur in the fall, outside of the spring nesting season. Since only a small percentage of habitats would be treated at any one time, the loss of eggs or nestlings would not result in a measurable negative effect on the migratory birds populations listed above.

Locally Important Species

Two locally important species that occur in the project area were identified by Forest Service and US Fish and Wildlife biologists. The Arizona toad and the Arizona Black Rattlesnake.

The project could affect individual animals. Snakes or toads could be hit by vehicles associated with project implementation. Activities related to implementation could disturb individuals or interfere with hunting or foraging. However, overall there would not be a measurable negative effect on these two species populations. Long-term habitat improvements would include improved habitat and a decrease in potential disturbance from road decommissioning.

Aquatics

The analysis of aquatic biota and habitat, as well as the endangered, threatened, and sensitive aquatic species and their occupied, critical, and recovery habitats, that occur within the Rim Country project area is part of the Aquatics Specialist report (USDA FS 2022), which is incorporated by reference.

The following sections describe the affected environment and effects of alternatives relating to threatened, endangered, and Forest Service sensitive species that may occur or have habitat in the project area. The analysis presented is summarized from the following report which is incorporated by reference: Aquatic Specialist Report for Rim Country (USDA FS 2022). The spatial and temporal context for the effects analysis is incorporated by reference from the Aquatics Specialist report.

Affected Environment

Watershed Condition

(Section added from DEIS aquatics specialist report for consistency)

The proposed project occurs within portions of 142 different 6th HUC subwatersheds. Of these watersheds, 38 have less than 5 percent of their total area within the project boundary. Overall, the project area is dominated by functional-at-risk (fair) subwatersheds (about 451,500 acres, or 46 percent of the analysis area), with several impaired (poor) subwatersheds (about 316,800 acres, or about 32 percent of the analysis area), and a few properly functioning (good) subwatersheds (about 220,400 acres, or about 22 percent of the analysis area). Forty-nine subwatersheds are within aquatic species analysis areas throughout this document.

Watershed Condition Framework (WCF) rankings were used to describe existing conditions for aquatic species analysis areas at this scale. Five indicators most relevant to water quality and aquatic species are discussed in more detail: aquatic habitat, aquatic biota, riparian/wetland vegetation, water quality, and roads and trails. A more comprehensive analysis of all Watershed Condition Framework scores for the Rim Country project area can be found in the Watershed Specialist report (USDA FS 2022).

For aquatic habitat, 10 subwatersheds were rated in good condition, 25 in fair condition, and 14 watersheds rated in poor condition based on habitat quality, fragmentation, and stream channel condition (see aquatics specialist report appendix B for a detailed list). Watersheds in ‘poor condition’ for aquatic habitat largely reflect past land uses (grazing, logging), including fragmentation by roads, lack of large wood in channels, and altered channel morphology. Many of these conditions continue to persist long after the original impact. For aquatic biota, 5 subwatersheds were rated in good condition, 27 in fair condition, and 17 watersheds were rated in poor condition based on community structure (natives vs. nonnative/invasive species) and continuity of populations.

For the riparian vegetation indicator, 9 subwatersheds were rated in good condition, 21 rated in fair condition, and 19 rated in poor condition based on relative condition and departure from potential. As with aquatic habitat, riparian conditions also reflect past land uses that are no longer active or allowed as well as current impacts (recreation, OHV).

For water quality, 25 subwatersheds were rated in good condition, 17 fair condition, and 7 rated in poor condition. This attribute rating is based on 303(d) status (percent of miles listed) and other known water quality impairments.

Watershed function and health, as they relate to roads and trails, were based on factors that include open road density, maintenance investment, and proximity to water. Two were rated in good condition, 22 rated in fair condition, and 25 watersheds rated poor condition. Road management is an ongoing agency emphasis, with national direction for transportation analysis to identify a ‘sustainable’ (economic, social, and ecological) road system, and develop a plan to reduce road impacts. Ongoing challenges include desire for public access for various purposes, needs for access for resource management and protection, and diminished funding for maintenance and storage or decommissioning of unneeded roads.

The desired condition is to have watershed function maintained or improved toward functioning properly (Good Rating). Watersheds would exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. Tree density would be reduced and moving toward the historical range. Unneeded roads would be decommissioned or restored to their natural condition improving the road and trail indicator. Soil and riparian condition and function would be improved and moving toward satisfactory and properly functioning.

Riparian Condition

Riparian Condition by aquatic species was determined averaging Watershed Condition Framework (WCF) scores for the riparian vegetation indicator for all subwatersheds within a species action area. This provides an overview of the riparian condition as it relates to each species and their associated habitat. Averages from 1 to 1.4 are considered Good, 1.5-2.4 is Fair, and 2.5-3.0 is Poor (table 60).

No species have riparian condition rated in good condition, which equates to functioning properly. Proper functioning condition indicates adequate vegetation, landform, and/or large woody debris are present to:

- Dissipate stream energy associated with high waterflow, thereby reducing erosion and improving water quality.
- Capture sediment and aid floodplain development.
- Improve flood-water retention and ground-water recharge.
- Develop root masses that stabilize streambanks against erosion.
- Maintain channel characteristics.

These watersheds have native vegetation in proper functioning condition throughout the stream corridor or along wetlands and water bodies. Native plant communities are vigorous, healthy and diverse in age, structure, cover and composition on greater than 80 percent of the riparian/wetland areas in the watershed. Sufficient reproduction of native species is occurring to ensure sustainability. Mesic herbaceous plant communities occupy most of their site potential and vegetation is in a dynamic equilibrium appropriate to the system.

Six species have riparian condition rated in fair condition, which is considered Functioning at Risk. These riparian areas are in limited functioning condition; however, existing hydrologic, vegetative, or geomorphic attributes make them susceptible to impairment. Disturbance partially compromises proper functioning condition of native vegetation attributes along stream corridors, wetlands, or water bodies. Native vegetation demonstrates a moderate loss of vigor, reproduction and growth, or changes in composition; particularly in areas most susceptible to human impact. Areas displaying light to moderate impact to structure, composition and cover may occupy 25 to 80 percent of the overall riparian area with only a few areas displaying significant impacts. Up to 25 percent of species cover or composition occurs from early seral species, but the communities across the watershed are still dominated by mid to late seral stages. Xeric herbaceous communities exist where water relationships have been altered but are relatively small, localized, and do not dominate across the watershed.

Four species have riparian condition rated in poor condition, which are considered Impaired. These riparian areas clearly are not providing adequate vegetation, landform, or woody material to dissipate stream energy associated with moderately high flows, and thus are not reducing erosion, improving water quality, etc. large percentage of native vegetation attributes along stream corridors, wetlands, and water bodies are not in proper functioning condition. Native vegetation is vigorous, healthy and diverse in age, structure, cover and composition on less than 75 percent of the riparian/wetland areas in the watershed. Native vegetation demonstrates a noticeable loss of vigor, reproduction and growth, and changes in composition as compared with site potential communities. In these areas, cover and composition are strongly reflective of early seral species dominance although there would be late and mid seral species present in pockets. Mesic dependent herbaceous vegetation is limited in extent with many lower terraces dominated by xeric species most commonly associated with uplands. Reproduction of mid and late seral species is very limited. For much of the area, the water table is disconnected from the riparian area and the vegetation reflects this loss of available soil water.

Table 60. Average riparian condition from watershed condition framework for species analysis areas

Species	Riparian Condition	Associated Rating
Gila trout	2.3	Fair
Gila chub	2.0	Fair
Gila topminnow	2.0	Fair
Little Colorado spinedace	2.5	Poor
loach minnow	2.0	Fair
spikedace	2.0	Fair
narrow-headed gartersnake	2.0	Fair
desert sucker	2.6	Poor
Sonoran sucker	2.7	Poor
Little Colorado sucker	2.3	Fair
headwater chub	2.4	Fair
roundtail chub	2.0	Fair
northern leopard frog	2.2	Fair

Threatened, Endangered, Sensitive Species, and Management Indicator Species Analyzed in Detail

Federally listed and Southwest Region Regional Forester Sensitive Species lists for all three Forests were screened to determine species that occur or have suitable habitat with the project and action area. Eleven federally listed species and 19 sensitive aquatic species occur within the three Forests. Of those, nine federally listed and 16 sensitive individual species will be analyzed in detail (table 61 and table 62). The narrow-headed gartersnake is a federally listed and sensitive species. The Aquatics Specialist report contains expanded information on each species analyzed and is incorporated by reference here (see Affected Environment, Threatened and Endangered Species Analyzed (pg. 25-39), Sensitive Species Analyzed in Detail (pg. 39-52), and Management Indicator Species (pg. 52-53).

Table 61. Federally listed and forest service sensitive aquatic species expected in the project area

Species	Status	Occurrence	Notes
Gila trout (<i>Oncorhynchus gilae</i>)	Threatened	Documented Occurrence	Occurs within the project and action areas
Little Colorado spinedace (<i>Lepidomeda vittata</i>)	Threatened, with designated Critical Habitat	Documented Occurrence	Occurs within the project and action areas
Gila chub (<i>Gila intermedia</i>)	Endangered with designated Critical Habitat	Documented Occurrence	Occurs outside the project area, but within the action area.
Gila topminnow (<i>Poeciliopsis occidentalis occidentalis</i>)	Endangered	Documented Occurrence	Occurs outside the project area, but within the action area.
Loach minnow (<i>Tiaroga cobitis</i>)	Endangered with designated Critical Habitat	Species not present, designated critical habitat does occur.	Occurs outside the project area, but within the action area.
Spikedace (<i>Meda fulgida</i>)	Endangered with designated Critical Habitat	Documented Occurrence	Occurs outside the project area, but within the action area.
Narrow-headed gartersnake (<i>Thamnophis rufipunctatus</i>)	Threatened, with proposed Critical Habitat & Sensitive	Documented Occurrence	Occurs within the project area
Desert sucker (<i>Catostomus clarki</i>)	Sensitive	Documented Occurrence	Occurs within the project area

Species	Status	Occurrence	Notes
Sonoran sucker (<i>Catostomus insignis</i>)	Sensitive	Documented Occurrence	Occurs within the project area
Little Colorado sucker (<i>Catostomus</i> sp. 3)	Sensitive	Documented Occurrence	Occurs within the project area
Headwater chub (<i>Gila nigra</i>)	Sensitive	Documented Occurrence	Occurs within the project area
Roundtail chub (<i>Gila robusta</i>)	Sensitive	Documented Occurrence	Occurs within the project area
Northern leopard frog (<i>Lithobates pipiens</i>)	Sensitive	Documented Occurrence	Occurs within the project area
Netwing midge (<i>Agathon arizonicus</i>)	Sensitive	Documented Occurrence	Occurs within the project area
A Mayfly (<i>Fallceon eatoni</i>)	Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the project area.
A Stonefly (<i>Capnia caryi</i>)	Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the project area.
Parker's cyloopeus riffle beetle (<i>Cylloepus parkeri</i>)	Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the project area.
A Mayfly (<i>Moribaetis mimbresaurus</i>)	Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the project area.
A Caddisfly (<i>Lepidostoma apache</i>)	Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the project area.
A Caddisfly (<i>Lepidostoma knulli</i>)	Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat exists in the project area.
A Caddisfly (<i>Limnephillus granti</i>)	Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat of springs in ponderosa pine exist within the project area.
A Caddisfly (<i>Wormaldia planae</i>)	Forest Service Sensitive	Documented Occurrence	Occurs within the action area
Ferris' copper (<i>Lycaena ferrisi</i>)	Forest Service Sensitive	Suspected to Occur	Little is known about the species, but suitable habitat of herbaceous wetlands exist within the project area.
Nokomis fritillary (aka Great Basin Silverspot) (<i>Speyeria nokomis nokomis</i>)	Forest Service Sensitive	Documented Occurrence	Little is known about the species, but suitable habitat of herbaceous wetlands and streams exist within the project area.
Fossil springsnail (<i>Pyrgulopsis simplex</i>)	Forest Service Sensitive	Documented Occurrence	Occurs within the action area
California floater (<i>Anodonta californiensis</i>)	Forest Service Sensitive	Documented Occurrence	Occurs within the project and action areas
Aquatic macroinvertebrates (various species)	Management indicator species (Tonto National Forest only)	Documented Occurrence	Occurs within the project and action area

Table 62. Federally listed and Forest Service sensitive aquatic species not analyzed in detail

Species	Status	Occurrence	Notes
Apache trout (<i>Oncorhynchus gilae apache</i>)	Threatened	No Documented Occurrence	Does not occur within the project or action area

Species	Status	Occurrence	Notes
Colorado pikeminnow (<i>Ptychocheilus lucius</i>)	Experimental-Nonessential Population	No Documented Occurrence	Does not occur within the project or action area
Razorback sucker (<i>Xyrauchen texanus</i>)	Endangered with designated Critical habitat	No Documented Occurrence	Does not occur within the project or action area
A Caddisfly (<i>Wormaldia planae</i>)	Forest Service Sensitive	Not Suspected to Occur	Does not occur in the project area, and elevation range is lower than that of the project.
Balmorhea saddle-case Caddisfly (<i>Protoptila balmorhea</i>)	Forest Service Sensitive	Not Suspected to Occur	Does not occur in the project or action area, associated ecological response unit semidesert grassland does not occur.

Assumptions and Methodology

Assumptions

- Species occurrence geospatial layers utilized for analysis contain up-to-date information as of December 2020 and represent species current occurrence as well as potential suitable habitat.
- Species analysis areas represent the drainage network where direct and indirect effects could occur to species or habitat.
- Watershed Condition Framework assessments utilized for existing condition accurately reflect indicators for aquatic species and habitats.
- Analyzing mechanical vegetation and prescribed burning treatments across vegetation types will address the highest level of effects that may occur; therefore, effects less than that are inherently addressed.
- Low water road-stream crossings are likely to occur on maintenance level 1-2 roads because they are not for passenger car use.
- Project implementation would include all applicable Design Features, Best Management Practices, and Conservation Measures which are expected to minimize effects throughout the analysis.
- The Aquatic and Watershed condition-based management approach is adaptive management and guidance within the document would be implemented, including circumstances on where treatments are applicable, which inherently minimize effects on aquatic species and habitats.
- Projects lists and acreages provided for Cumulative Effects analysis accurately represent past, current, and future activities within the project area.

Methodology

This analysis is for a total of 28 endangered, threatened, proposed, candidate, and sensitive aquatic species and their habitats. The species analyzed include twelve fish species, two mollusks, two gartersnakes, and twelve invertebrates. For analysis and discussion purposes, some of the species were grouped together, where appropriate, as this facilitates the comparison of changes between alternatives. Analyses compared and summarized the resource indicators and measures identified below (see table 63). For invertebrate species, more qualitative analyses were required, primarily due to the unknown distributions of most of these species, limited distribution of these species, or the limited effects on these species associated with the proposed actions. Analyses included the changes (such as, increase, decrease, or change from current conditions) for the indicators or measures, and how they can affect aquatic species and their habitats.

For the purposes of analysis, mechanical vegetation treatments were analyzed across vegetation type (ecological restoration unit) within the project area. Intuitively, mechanical vegetation treatments in forested ecological restoration units (ERUs) would be more extensive to move toward desired conditions than treatments in savannas, grasslands, meadows, and riparian areas to reduce encroachment. Prescribed burning was similarly analyzed across the project area regardless of vegetation type (ERUs).

The transportation system (roads) needed to implement Rim Country were analyzed quantitatively and qualitatively. Quantitative analysis was completed based on existing Forest Service roads (existing condition) and the number of ML-1 roads opened (action alternatives). While the analysis assumes all ML-1 roads would be opened for use, intuitively not all the roads would be opened or used at the same time across the project area. It also assumes all ML-1 roads are currently closed and not in use; therefore, the analysis is overestimating the potential effects of the action alternatives. The miles of roads (ML-1 thru 5) to be used is the same for both action alternatives as was therefore analyzed only once. Road relocation, decommissioning, and temporary roads were analyzed qualitatively for the action alternatives as the location of these activities is unknown. Miles proposed for each were based on averages across the three Forests over a given time period. Therefore, a more accurate analysis by species was not feasible. Miles of proposed road relocation and decommissioning were the same for both action alternatives and therefore only analyzed once. Mileage of temporary roads differed between the action alternatives and was analyzed as part of those alternatives.

In-woods processing and storage sites, rock pits, and aquatic/watershed restoration activities do not differ in acreage or mileage between the action alternatives. For those reasons, these three portions of the action alternatives were analyzed only once as Effects Common to Both Action Alternatives. In-woods processing and storage sites were analyzed quantitatively for the Coconino and Tonto National Forests where exact locations and acreages of proposed sites were available. A qualitative analysis was completed for the Apache-Sitgreaves National Forests because the use of identified processing sites on those forests are not being proposed, only the in-woods drying of biomass as needed. The acres of rock pit use and expansion were analyzed quantitatively, as were miles of general and heavy mechanical stream restoration.

Spatial and Temporal Context for Effects Analysis

The spatial analysis area includes the entire Rim Country project Area and adjacent areas that could be affected by activities occurring downstream of the proposed project area, or adjacent lands. The analysis area will vary by the species present within and downstream of Rim Country subwatersheds, and the extent and location of proposed activities within the various alternatives. For GIS quantitative analyses, areas for most of the aquatic species were developed to include all potential effects. Species analysis area boundaries were determined by including all of the subwatersheds within the project area that drain into occupied or suitable habitat, designated or proposed critical habitat, and identified recovery habitat. Additional spatial boundaries within each species analysis areas were defined specifically to delineate direct and indirect effects; these are described below.

Miles of stream identified for general and heavy mechanical stream restoration were identified spatially using factors that promote successful treatments. Potential locations for general stream treatments were identified based on stream gradient. Stream gradient was mapped using LiDAR data and averaging within reaches. Reaches with low (0 to 2 percent) and moderate (2 to 4 percent) stream gradient were used for general stream treatment identification based on Rosgen stream types and gradients where stream restoration is the most successful. Heavy mechanical stream reaches are a subset of the general stream dataset that were then filtered by the ability of machinery to access locations. These were identified by removing reaches with canyon slopes greater than 25 percent and further than 0.25 mile from roads. The canyon slope was used to be in alignment with existing design features.

Direct and Indirect Effects Boundaries

The action area is defined as the project area and all 6th HUC subwatersheds that intersect with the project area. The full extent of the action area is shown in figure 2. This accounts for any downstream effects that may occur from project activities and includes up to 142 subwatersheds. For each species, effects were analyzed for alternatives in two ways: within species habitats and riparian corridors and outside habitats within subwatersheds (species action areas) that drain into species habitat.

Actions that occur within species occupied or suitable habitat and riparian corridors which can have an immediate and direct effect/consequence to species or habitat were assessed using aquatic management zones defined in project design features. A 150-foot aquatic management zone on all aquatic species habitat was used to quantify treatments and analyze effects directly to species or habitats. For fish and gartersnakes, aquatic management zones along occupied or suitable habitat streams were utilized. Chiricahua and northern leopard frogs, which readily move along streams or overland, dispersal habitat was mapped using the 1-3-5 mile Chiricahua leopard frog recovery plan guidelines from all currently occupied sites within or near the project boundary and any known proposed stockings in the next 5 to 10 years. Dispersal habitat includes streams and stock tanks where frogs could move during the life of the project. Aquatic management zones on every stream and stock tank were used to quantify treatments and address effects to frogs and their habitat. Dispersal mapping was reviewed and refined by district personnel familiar with their populations and habitat.

Effects to riparian and aquatic habitat from upstream or upland treatments were assessed by species action areas as defined in the affected environment. For fish and gartersnakes, 6th HUC subwatersheds outside of species habitats (aquatic management zones) equate to species action areas. For frogs, dispersal areas outside of species habitats define the action areas. Proposed treatments within species action areas and outside of aquatic management zones, were quantified to capture all potential consequences that could occur using riparian condition as a baseline. Riparian areas and their condition strongly influence aquatic habitats. Therefore, changes to riparian condition can affect aquatic habitat quality and quantity in a positive, negative or neutral manner.

Designated or proposed critical habitat was similarly addressed by actions occurring within critical habitat and actions upstream or within uplands. Actions within or draining into critical habitat were quantified and any effects to primary constituent elements or primary biological features addressed. Assessment of indirect effects differed for frogs as compared to fish and gartersnakes. Fish and gartersnake critical habitat occur solely along streams, therefore all subwatersheds that drain into the proposed or designated habitat were used to quantify treatments and analyze effects. Chiricahua leopard frog critical habitat occurs in uplands and small segments of streams; therefore, indirect action areas were mapped by identifying the uplands that drained into each critical habitat polygon which was smaller than the entire watershed.

The temporal boundaries for analyzing effects to aquatic species will be 10 to 15 years given habitat conditions and species occupancy can change over that timeframe. Short-term effects occur over a timeframe of less than 5 years to factor in at least one entire growing season for vegetation, such as within a single timber pay unit or prescribed burn. Long-term effects to habitat can last for longer than 5 years or seasons to address entire sale areas within multiple subwatersheds.

Resource Indicators and Measures

Resource measures were identified for those components that could be spatially defined and carried through the analysis of alternatives. Quantitative analyses were conducted for the following resource measures: (1) acres of mechanical thinning, (2) acres of prescribed burning, (3) miles of open ML-1, (4) acres of in-woods processing sites, (5) acres of rock pits use and expansion, (6) miles of general stream restoration, and (7) miles of heavy mechanical stream restoration. For some species (for example,

sensitive aquatic macroinvertebrates), quantitative evaluation is not possible, so the analyses will be more limited and/or qualitative for some species.

Qualitative analyses were used for components that could not be spatially defined such as temporary roads, road relocation, and road decommissioning which are part of both action alternatives. Resource indicators will allow for the comparison between the existing condition and each alternative, and how they may directly or indirectly impact aquatic species and their habitats. Resource elements are larger in context and represented by the resource indicators for analysis. For example, riparian condition represents both aquatic habitat quality and quantity. Measures represent the amount effect to the resource indicators; therefore, if acres or miles of measures increase then potential effects to resource indicators may increase. Impacts to indicators will be addressed on the temporal context described previously as well as by direct and indirect impacts. Additional information is provided later for each group of species (such as, fish, frogs, snakes, and invertebrates) analyzed within the effects sections. The resource indicators, elements, and measures are listed in table 63.

Aquatic invertebrate sensitive species were not quantitatively analyzed using the resource indicators and measures. This was not possible primarily due to the species limited or unknown distributions, or no or limited impacts that could result from the proposed actions. GIS maps were reviewed for both alternatives to qualitatively assess the impacts that could occur to these species from the proposed actions (such as, mechanical vegetation treatments and prescribed burning).

Table 63. Resource indicators and measures for assessing effects between alternatives

Resource Element	Resource Indicator	Measure	Used to address: P/N, or key issue?	Source (LMP S/G; law or policy, BMPs, etc.)?
Habitat Quality Habitat Quantity Impacts to Individuals	1. Riparian Condition - Short-term effects negative - Long Term effect neutral or positive 2. Modification of Gartersnake Behavior - Short-term effects negative - Long-term effect neutral or positive 3. Harm of Gartersnakes - Short-term effects negative - Long-term effects neutral 4. Pollutants, Exotic Species and/or Disease - Short- and long-term effects negative	Acres of mechanical thinning treatments	Yes	LMP S/G, BMPs
Habitat Quality Habitat Quantity Impacts to Individuals	1. Riparian Condition - Short-term effects negative - Long-term effect neutral or positive 2. Modification of Gartersnake Behavior - Short-term effects negative - Long-term effect neutral or positive 3. Harm of Gartersnakes - Short-term effects negative - Long-term effects neutral 4. Pollutants, Exotic Species and/or Disease - Short- and long-term effects negative	Acres of Prescribed Burning	Yes	LMP S/G, BMPs
Habitat Quality Habitat Quantity	1. Riparian Condition - Short-term effects negative - Long-term effect neutral or positive 2. Habitat Connectivity - Short-term effects negative - Long-term effect neutral or positive 4. Pollutants, Invasive Species - Short- and long-term effects negative	Miles of Open ML-1 and Temporary Roads (Road Density and Location), temporary roads, and low water crossings	Yes	LMP S/G, BMPs
Habitat Quality Habitat Quantity	1. Riparian Condition - Short-term effects negative - Long-term effect neutral	Acres of In Woods Processing Sites (IWPS)	Yes	LMP S/G, BMPs
Habitat Quality Habitat Quantity	1. Riparian Condition - Short-term effects negative - Long-term effect neutral	Acres of Rock Pits	Yes	LMP S/G, BMPs
Habitat Quality Habitat Quantity	1. Riparian Condition - Short-term effect negative - Long-term effects neutral or positive	Miles of general stream restoration	Yes	LMP S/G, BMPs
Habitat Quality Habitat Quantity Impacts to Individuals	1. Riparian Condition - Short- and Mid-term effects negative - Long-term effect neutral or positive 2. Instream Aquatic Habitat - Short-term effects negative - Long-term effects positive 3. Harm of Fish or Gartersnakes - Short-term effects negative - Long-term effect neutral or positive 4. Pollutants, Invasive Species - Short- and long-term effects negative	Miles of heavy mechanical stream restoration	Yes	LMP S/G, BMPs
Habitat Quality and Quantity for Invertebrates	1. Riparian Condition - Short-term effects negative - Long-term effects neutral or positive	Qualitative change in sediment delivery or habitat impacts.	Yes	LMP S/G, BMPs

Riparian Condition

Riparian Condition is being used as a surrogate to indicate potential changes in multiple factors that directly influence aquatic and riparian habitat quality and quantity such as sediment load, streamside canopy cover and structure, large woody debris, stream temperature, and changes in peak flows. The current condition of riparian areas indicates their ability and resiliency to provide the ecosystem services listed above in regard to potential direct and indirect impacts. Therefore, riparian areas in good condition would ameliorate potential short-term direct impacts to riparian and aquatic habitat whereas areas in poor condition potentially would not. Additionally, resource measures could lead to positive or negative impacts to riparian condition (and thus aquatic or riparian habitat) depending on the timeframe.

Effects on riparian condition will be assessed quantitatively by alternative by comparing predicted direct, indirect, and cumulative effects by major proposed activities within the project area.

Habitat quality and quantity analysis topics include:

- Changes in streamside vegetation cover and structure.
- Changes in sediment delivery to streams altering aquatic habitat and food base.
- Changes in recruitment of large woody debris from riparian areas to streams altering aquatic habitat.
- Changes to stream temperatures as a result of warm water runoff from upland sources or reduced streamside canopy cover.
- Changes to aquatic habitat as a consequence of increased flows caused by removal of upland vegetation resulting in increased storm water runoff.

Environmental Consequences

Alternative 1 – No Action

There would be no direct effects on resource indicators for aquatic species and habitats as a result of the no action alternative, however there would be indirect effects by not moving these resources toward desired conditions. Existing conditions for watersheds would remain degraded and associated loss of habitat would continue which could potentially lead to reductions in populations over time. Overstocked and dense stands within the project area would not be treated, leaving a less healthy, less vigorous, and under productive forest. Encroachment of conifers into riparian areas and wetlands would continue, which could decrease shrub and herbaceous ground cover as well as soil hydrologic function (USDA FS 2022). Current or reduced riparian and watershed conditions of Fair or Poor would continue to limit the quality of aquatic habitat and therefore species occupancy. Consequently, alternative 1 would not be beneficial for riparian condition, aquatic habitat quality, or aquatic species.

Effects Common to Both Action Alternatives

Tonto Land Management Plan Amendment

The Rim Country Project proposes one project level amendment with three exceptions for the Tonto National Forest Land Management Plan. These amendment exceptions are for ponderosa pine vegetation treatment/forest cover types, Mexican spotted owl, and slope restrictions.

Exception 1 would update guidance and direction in the Tonto National Forest Land Management Plan, so it is consistent with the Apache-Sitgreaves and Coconino National Forests revised land management plan

management direction. This amendment exception does not impact the analysis for aquatic species or habitats for any alternative.

Exception 2 would update definitions, language, and treatments within Mexican spotted owl habitat. It does not impact the analysis for aquatic species or habitats for any alternative.

Exception 3 would remove language from the Tonto Land Management Plan restricting mechanical equipment to slopes less than 40 percent as well as removing language that identifies those slopes as inoperable. Rim Country proposed the use of specialized mechanical equipment to restore steep slopes. The acreages of mechanical vegetation treatments analyzed for aquatic species and habitats includes steep slopes with specialized equipment only for both action alternatives across all three Forests.

Opening ML-1 Roads

For alternatives 2 and 3, it is assumed that all ML-1 roads may be opened to facilitate vegetation management treatments and closed once treatment units are completed. Use of ML-1 roads add to the open road density when combined with ML2-5 roads (table 64). For further explanation see the transportation specialist report.

Table 64. Change in miles of open Forest Service roads treatments for alternatives 2 and 3 as compared to alternative 1 within the project area

Maintenance Level	Alternative 1 Total Open Road Miles	Alternatives 2 & 3 Potential Open Road Miles
1- Basic Custodial Care (closed)	0	2,184
2 - High Clearance	3,055	3,055
3 - Suitable for Passenger Vehicles	673	673
4 - Moderate Degree of User Comfort	68	68
5 - High Degree of User Comfort	3	3
Total System Roads	3,799	5,983

Opening of ML-1 roads has the potential for direct short-term impacts to aquatic indicators while the roads are in use. Negative effects would result when ML-1 roads occur within species habitat (aquatic management zones). Increases in miles of open roads ranges from 1 to 26 miles (2 to 78 percent) within habitat for nine species or associated critical habitat is proposed for both action alternatives. The eight species or associated critical habitat have no increases in open roads and therefore no impacts.

Water runoff and sediment yield are key physical processes whereby roads have an impact on streams and other aquatic systems, and the distance of these effects can vary widely. Roads on upper hillslopes concentrate water flow, which can form channels higher on slopes. This process leads to smaller, more elongated first-order drainages and longer total length of the channel network. Water rapidly runs off relatively impervious road surfaces, especially in storm and snowmelt events, increasing runoff. Increased runoff associated with roads may increase the rates and extent of erosion, reduce percolation and aquifer recharge rates, alter channel morphology, and increase peak flows. Increased peak flows can degrade aquatic ecosystems by altering riparian conditions, channel morphology, or aquatic habitat. Surface erosion from forest roads affects the fine sediment budget and may impose a chronic condition of sediment inputs to streams affecting the stream substrate and the health of aquatic life (Luce et al. 2001). Chronic erosion from roads can greatly reduce an aquatic systems integrity, and in some cases can be the primary source of sediment input (Switalski et al. 2004). Sediment concerns are generally highest when roads are not sufficiently drained; with sufficient drainage, water and sediment from upland segments of roads can be diverted, filtered through forest vegetation, and not routed to streams. As such, upland segments of roads can generally be designed to mitigate sediment delivery concerns.

Road density in a watershed affects the collection and transport of water out of the watershed (Burroughs and King 1989, Forman and Alexander 1998). The potential for increases in runoff rates increases with more miles of road. Road closures would be beneficial to water quality if the roads were properly decommissioned and well maintained after closure. A well-maintained, closed road system would result in less sediment from road surface erosion. Roads not proposed for use in the project area may have long-term adverse effects on water quality if they are not properly maintained. For this analysis, it is assumed that when a road is closed it will continue to have impacts on the aquatic system, and both of the action alternatives involve the closure of ML 1 roads and temp roads to use by the public rather than the physical removal of roads.

The primary concern is erosion and sediment delivery from roads that are near streams and that cross streams. Fine sediment is a key physical element to focus on when attempting to delineate land management impacts on aquatic habitat and biota (Rinne 1996). Excessive fine sediment input into a stream can fill pool habitat and reduce both summer and winter rearing habitat for juvenile fish (Heede and Rinne 1990). Stream crossings reduce riparian vegetation and widening of the channel which can also impact water temperature (Poole and Berman 2001, Beschta 1997, and Heede 1980). Not all species and ecosystems are equally affected by roads, but overall, the presence of roads is highly correlated with changes in species composition, population sizes, and hydrologic and geomorphic processes that shape aquatic and riparian systems (Trombulak and Frissell 2000).

Chiricahua and northern leopard frogs have the largest increases in ML-1 mileage within their habitat with a potential for 26 and 14 miles respectively. Seven species potentially have 1-3 miles of ML-1 roads within their habitat. Therefore, alternatives 2 and 3 would result in more negative impacts to individuals and habitat by opening ML-1 roads than alternative 1.

Opening ML-1 roads can cause negative short-term impacts to riparian condition, habitat connectivity, individuals. Effects within species habitat to riparian condition include reduced riparian vegetation cover or structure, and removal of vegetation. This would negatively affect leopard frog and gartersnake hiding cover and individuals, particularly if roads occur along streams given these species utilize riparian corridors. Impacts of increased stream temperature could also occur from reduction in canopy cover within riparian areas. Associated ground disturbance and increased sedimentation delivery to riparian areas and streams is expected to occur short-term until the roads were closed.

Pollutants, aquatic invasive species, and disease can be introduced to aquatic systems from machinery or vehicles utilizing ML-1 roads but are not expected given implementation of project design features. Pollutants in the form of fuels and lubricants have the potential to be introduced into aquatic systems from staging areas and equipment. Spills and leaks can introduce pollutants to soils and then to streams and riparian areas reducing riparian condition and habitat quality. However, there are six design features to prevent contaminants from entering riparian areas, waterbodies and aquatic habitats which minimizes the potential impact. These measures range from checking for leaks daily to refueling and staging areas being outside AMZs (AQ003, SW015-16, SW074). Similarly, aquatic invasive species or diseases can be introduced to aquatic systems from machinery or vehicles creating or using temporary roads. However, design features for decontamination of equipment (AQ001, AQ023, AQ028, AQ038) and not transferring water or materials (AQ026) are expected to reduce potential introduction or spread of invasive species. Implementation of project design features are not expected to introduce or spread any pollutants, disease, or aquatic invasive species.

Table 65. Change by species in miles of open ML 1 Forest Service roads for alternative 2 and 3 as compared to alternative 1. Percentages reflect changes in miles of ML-1 roads within species habitat.

Species	Alternative 1: Miles of Open Forest Service Roads	Alternatives 2 & 3: Miles of ML1 Roads/ Percent Increase
Gila trout	3	5/ 33%
Gila chub and critical habitat	0	0
Gila topminnow	0	0
Little Colorado spinedace	3	4/ 18%
Little Colorado spinedace critical habitat	<1	<1/ 0%
loach minnow critical habitat	0	0
spikedace	0	0
spikedace critical habitat	0	0
narrow-headed gartersnake	1	2/63%
narrow-headed gartersnake critical habitat	<1	<1/ 0%
Chiricahua leopard frog	67	93/ 38%
Chiricahua leopard frog critical habitat	<1	<1/ 0%
desert sucker	8	11/ 32%
Sonoran sucker	2	2/ 0%
Little Colorado sucker	4	5/ 16%
headwater chub	5	5/ 2%
roundtail chub	1	2/ 27%
northern leopard frog	17	31/ 78%

Effects to riparian condition could occur from opening ML-1 roads outside aquatic management zones but within species action areas for all species and critical habitat analyzed (table 66). Increases in miles of open roads range from 9 percent to 133 percent (5-514). Narrow-headed gartersnake and Sonoran sucker have the largest increases in road mileage. Little Colorado sucker and Little Colorado spinedace have the largest increases in road mileage within their action areas. Gila chub, Gila topminnow, loach minnow critical habitat, spikedace and its critical habitat have the lowest increases in open ML-1 road mileage since only a portion of the subwatershed action areas are within the project area. Alternatives 2 and 3 would have more direct impacts from opening ML-1 roads within species action areas than alternative 1.

Negative impacts to riparian condition could occur from opening ML-1 roads in the upper watershed. In general, roads compact soils and reduce infiltration of water leading to increased erosion and runoff. They increase the drainage network to riparian areas and streams and connect these areas to the uplands by altering surface water pathways. This converts dispersed surface runoff and sediment filtering through a riparian area to direct deliveries of accumulated runoff and sediment. Pollutants and aquatic invasive species can be transferred to aquatic systems from machinery or vehicles. Leaking fuels or lubricants can be transferred to aquatic systems from vehicles, machinery, or fuel storage areas. Aquatic invasive species can similarly be transferred from an infected water body to an uninfected waterbody through driving.

Roads not only impact perennial and intermittent streams where aquatic species and riparian areas are present, but influence these habitats where they are located adjacent to or cross ephemeral channels in the watershed. Ephemeral streams indirectly support aquatic populations by providing required nutrients and other materials to the perennial streams.

Table 66. Change by species in miles of open Forest Service roads for alternative 2 and 3 as compared to alternative 1. Percentages reflect changes in acreages within species action areas.

Species	Alternative 1: Miles of Open Forest Service Roads	Alternatives 2 & 3: Miles of Open Forest Service Roads/ Percent Increase
Gila trout	247	408/ 65%
Gila chub* and critical habitat	59	70/ 9%
Gila topminnow*	63	70/ 11%
Little Colorado spinedace	789	1,303/ 65%
Little Colorado spinedace critical habitat	312	394/ 26%
loach minnow critical habitat	63	70/ 11%
spikedace*	63	70/ 11%
spikedace critical habitat*	111	125/ 12%
narrow-headed gartersnake	108	253/ 133%
narrow-headed gartersnake proposed critical habitat	86	142/ 65%
Chiricahua leopard frog	392	603/ 54%
Chiricahua leopard frog critical habitat	74	87/ 18%
desert sucker	1,053	1,535/ 46%
Sonoran sucker	116	254/ 118%
Little Colorado sucker	820	1454/ 77%
Headwater chub	722	861/ 19%
Roundtail chub	478	930/ 95%
northern leopard frog	200	322/ 61%

*While the percentage is high for these species action areas, less than half of entire watershed is within the project area.

Potential indirect effects are expected to vary based on current riparian condition. Species with riparian conditions that are currently poor are expected to have a higher level of indirect effects from sedimentation and peak flows. They are currently not capturing or processing sediment, indicating more could potentially reach stream from direct delivery. Stream energy from increased peak flows and concentrated flows would not be dissipated potentially altering instream habitats. Riparian areas that are functioning at risk or properly functioning would be capable of processing some levels of sediment and peak flows; however, the concentrated delivery from roads would still have negative impacts over the timeframe until they were closed.

Opening ML-1 roads would also increase road density during the timeframe that proposed project activities are occurring. This would negatively impact the Roads and Trails indicator for Watershed Condition Framework in the interim impacting one of the five factors associated with aquatic species and habitats.

Design features for roads are expected to reduce some of the potential impacts to aquatic species and habitats. Minimizing disturbance of existing vegetation in ditches and at stream crossings during maintenance. New cross drains would discharge to stable areas where the outflow would quickly infiltrate the soil and not develop a channel to a stream. Whenever possible, use existing stream crossings unless a new crossing would result in less resource damage.

Low Water Crossings

Low water road crossings can cause negative short-term impacts to riparian condition, habitat connectivity, individuals, and introduction of pollutants or aquatic invasive species that are similar to the discussion above on ML-1 roads. Low water road crossings can alter riparian condition by reducing

riparian vegetation cover or structure, impacting stream channel function and structure, and alter and degrade aquatic habitat through changes in water quality from increased sedimentation. Increased low water stream crossings can also cause harm to individuals when they occur within species habitat or aquatic management zones. Increases in low water stream crossings and associated impacts within species aquatic management zones could occur for four species with the largest increase in crossings (+186) occurring for Chiricahua leopard frog (table 67). Associated ground disturbance and direct impacts is expected to occur short-term until the ML-1 roads were closed. Design feature SW033 would reduce the amount of sedimentation by requiring either constructed features (culvert) or fill material at crossings that would be removed when ML-1 roads were closed.

As discussed above for ML-1 roads, pollutants and aquatic invasive species or diseases can be introduced by vehicles or equipment into aquatic habitat. While these are adverse effects, implementation of multiple design features discussed previously preclude the potential for this to occur.

Table 67. Number of low water road/stream crossings on perennial and intermittent streams for proposed action as compared to existing condition within species habitat or critical habitat. Increases in number of low water crossings reflect opening ML-1 roads.

Species	Current number of low water crossings from ML-2 roads within species AMZs	Proposed action number of low water crossings with ML-1 roads within species habitat
Gila trout	9	16/ 177%
Gila chub and critical habitat	0	0/ 0%
Gila topminnow	0	0/ 0%
Little Colorado spinedace	1	2/ 200%
Little Colorado spinedace critical habitat	0	0/ 0%
loach minnow critical habitat	0	0/ 0%
spikedace	0	0/ 0%
spikedace critical habitat	0	0/ 0%
narrow-headed gartersnake	2	7/ 140%↑
narrow-headed gartersnake proposed critical habitat	3	3/ 0%
Chiricahua leopard frog	320	506/ 158%↑
Chiricahua leopard frog critical habitat	0	0/ 0%
desert sucker	18	26/ 44%↑
Sonoran sucker	1	1/ 0%
Little Colorado sucker	4	5/ 25%↑
headwater chub	15	15/ 0%
roundtail chub	1	1/ 0%
northern leopard frog	56	84/ 50%↑

AMZs – aquatic management zones

Within species action areas, there is potential for increased sedimentation from additional road stream crossings within watersheds could occur for all species and associated critical habitat. Increases in low water stream crossings range from 2 to 213 from opening of ML1 roads (table 68). Gila trout, Little Colorado spinedace, and Chiricahua leopard frog analysis areas have the highest increases while species outside the project area have the lowest.

Potential effects are expected to vary based on current riparian condition and number of crossings within the indirect analysis areas. Species with riparian conditions that are currently impaired (spinedace and frog) are expected to have a higher level of effects from sedimentation because riparian areas are

currently not capturing or processing sediment, indicating more could potentially reach stream from direct delivery. Riparian areas that are functioning at risk or functioning properly should be capable of processing some levels of sediment; however, increased sediment could still have negative impacts over the short-term timeframe until ML-1 roads were closed.

Table 68. Number of low water road/stream crossings on perennial and intermittent streams for proposed action as compared to existing condition outside species aquatic management zones, but within species or critical habitat action areas. Increases in number of low water crossings reflect opening ML-1 roads.

Species	Current number of low water crossings from ML-2 roads in species action areas	Proposed action number of low water crossings with ML-1 & 2 roads in species action areas
Gila trout	240	453/ 89%
Gila chub and critical habitat	61	62/ 2%
Gila topminnow	29	31/ 7%
Little Colorado spinedace	184	375/ 104%
Little Colorado spinedace critical habitat	126	213/ 69%
loach minnow critical habitat	29	31/ 7%
spikedace	29	31/ 7%
spikedace critical habitat	91	93/ 2%
narrow-headed gartersnake	64	133/ 108%
narrow-headed gartersnake critical habitat	64	138/ 116%
Chiricahua leopard frog	320	506/ 63%
Chiricahua leopard frog critical habitat	36	53/ 47%
desert sucker	540	866/ 60%
Sonoran sucker	76	138/ 82%
Little Colorado sucker	184	384/ 109%
headwater chub	365	522/ 43%
roundtail chub	168	301/ 79%
northern leopard frog	56	84/ 50%

In-woods Processing Sites (IWPS) and Storage Sites

No direct effects to any aquatic indicators are expected to occur from in-woods processing sites (table 69). None of the proposed in-woods processing sites occur within 0.4 mile of occupied or suitable habitat. In addition, they occur within conifer ERUs (Ponderosa Pine, Ponderosa Pine-Evergreen Oak, Mixed Conifer w/ Aspen, and Mixed Conifer) and not within any riparian areas.

Indirect impacts from in-woods processing sites have the potential to occur to seven of the species based on their action areas. Two species (Gila trout and Sonoran Sucker) would have no indirect impacts. Acreages of in-woods processing sites range from 3.1 to 57.4 acres for both gartersnakes and desert sucker, respectively). Negative indirect impacts to riparian condition in the form of sedimentation are possible but limited based on less than 0.5 percent of any species action area being impacted. In-woods processing sites would also have limited negative impacts to aquatic macroinvertebrates based on the very low percentage of in-woods processing sites acreage in any of the subwatersheds. For California floater, only two watersheds have the potential for any indirect impacts, with a total of approximately 72 acres of in-woods processing sites within those watersheds. The other aquatic macroinvertebrates share similar stream and riparian habitats with fish and gartersnakes; therefore, overall acreages of in-woods processing sites are still below 1 percent combined.

The Apache-Sitgreaves National Forests do not have any of the identified in-woods processing sites; instead, they would allow biomass (needles, tree tops and branches up to 5 inches) waiting to be processed to remain on forest during mechanical operations for up to 90 days. The timeframe allowed may be shortened based on conditions such as fire risk preparedness levels.

Allowing biomass to stay on the Apache-Sitgreaves National Forests should not directly impact aquatic species or habitats but could have indirect impacts. Piling of any kind is not allowed within Aquatic Management Zones; therefore, this action should not have any effects within species habitats. Effects within action areas could include soil disturbance from machinery moving material to and from the piles as well as hauling from soil disturbance depending on the equipment used. Piling with front end loaders, as an example, can be more ground disturbing. Soil disturbance can lead to erosion and contribute fine sediment to streams negatively impacting aquatic habitat, species, and water quality; particularly eggs and early life stages that occur on or within substrate and aquatic macroinvertebrate community structure. Habitat can be negatively impacted by filling of spawning substrates which can lead to loss of habitat quality and reduced reproductive success. Excessive fine sediment can impact macroinvertebrate prey bases and other food sources such as algae.

Similarly, leaving biomass should not directly impact sensitive invertebrates, but could have indirect impacts. For aquatic invertebrate species, increased fine sedimentation can lead to physical effects as well as changes in habitat and food availability and quantity. Physical effects include abrasion, clogging of gills and filter-feeding apparatus, burial, and changes in substrate composition (Jones et al. 2012). Bivalve mollusks, such as California floater, are capable of expelling unwanted particles from their gills but can also expend more energy doing so than is gain from feeding. Filter feeding caddisfly larvae are generally not present in streams receiving high inputs of fine sediment. Burial presents difficulties for sedentary animals, such as mollusks, but can affect motile invertebrates where rates of deposition are high. When inputs of fine sediment are increased in watersheds, interstices between large particles become filled which reduces refugia from predators or high-flow events. Most aquatic invertebrates are strongly associated with substrate composition; therefore, increased fine sediment can alter habitat availability. Increased sedimentation can also decrease the nutritional quality of periphyton (the film of attaches algae, fungi, bacteria, organic matter, and sedimented material found on the surface of stones). Some caddisflies, stoneflies, and mayflies are particularly impacted by sedimentation (Harrison et al. 2007).

In-woods processing sites could have negative short-term indirect impacts to riparian condition similar to landings. In general, soils can be compacted and water infiltration reduced leading to increased runoff and sediment delivery to riparian areas and streams. This can reduce riparian condition, aquatic habitat quality and quantity depending on its current condition.

Potential indirect effects are expected to vary based on current riparian condition. Riparian condition for the narrow-headed gartersnake, desert sucker and Sonoran sucker are currently impaired, therefore indirect effects are expected to be higher. Vegetation in these systems is not adequate to capture or process sediment, indicating more would reach streams. These riparian areas are often disconnected from the water table and are more reflective of upland species; therefore, unable to dissipate stream energy associated with increased peak flows. Riparian condition for five species is currently functioning at risk, therefore indirect effects are expected to be less. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and able to process sediment and dissipate flows in a limited capacity. Riparian condition for the remaining four species in Upper Fossil Creek is functioning properly. While indirect effects could occur, these riparian areas are able to process sediment and dissipate flows.

Table 69. Change by species in the acres of in woods processing sites for alternatives 2 and 3 as compared to alternative 1. Percentages reflect changes in acreages within species analysis areas. these are considered indirect impacts.

Species*	Alternative 1: Acres of In Woods Processing	Alternatives 2 & 3: Acres of In Woods Processing/ Percentage of Direct Effects Area
Gila trout	0	3/ 0%
Gila chub and critical habitat	0	0/ 0%
Gila topminnow	0	0/ 0%
Little Colorado spinedace	0	26/ 0.01%
Little Colorado spinedace critical habitat	0	7/ 0.01%
loach minnow critical habitat	0	0/ 0%
spikedace	0	0/ 0%
spikedace critical habitat	0	0/ 0%
narrow-headed gartersnake	0	0/ 0%
narrow-headed gartersnake critical habitat	0	0/ 0%
Chiricahua leopard frog	0	28/ 0.02%
Chiricahua leopard frog critical habitat	0	20/ 0.02%
desert sucker	0	57/ 0.02%
Little Colorado sucker	0	26/ 0.01%
headwater chub	0	8/ 0.01%
roundtail chub	0	20/ 0.03%
northern leopard frog	0	20/ 0.02%

* Species with analysis areas that did not overlap with in-woods processing sites are not listed.

For those species with impaired or functioning at risk riparian condition, elevated sedimentation could negatively impact aquatic habitat, species, and water quality; particularly fish eggs and early life history stages that occur on or within substrate as well as the aquatic macroinvertebrate community structure. Habitat is impacted by filling of pools and spawning substrates which can lead to loss of habitat quality and reduced reproductive success. Peak flows can be increased altering channel forming flows leading to bank erosion and loss of habitat complexity. Reduction in riparian vegetation can lead to decreased organic matter input to support aquatic macroinvertebrates and increases stream temperature.

Potential indirect impacts of in woods processing sites and biomass storage could occur short term. However, given the low overall acreage within species action areas, indirect effects are considered to be minimal.

Rock Pit Development or Expansion

No direct effects to any aquatic species or habitats are expected to occur from rock pit use or expansion. None of the proposed rock pits occur within 0.5 mile of occupied or suitable habitat. Effects from rock pit use and expansion within species action areas in upper watershed have the potential to occur within five species action areas (table 70). Overall, those acreages are less than 1 percent of the species action areas. Design features for rock pits include limiting vegetation removal, erosion control, and reclamation which are expected to reduce any potential negative impacts to riparian condition from sedimentation.

Table 70. Change by species in the acres of existing rock pits sites and their expansion for alternatives 2 and 3 as compared to alternative 1. Percentages reflect changes in acreages within species analysis areas.

Species	Alternative 1: Acres of Rock Pits/ Percentage of Action Area	Alternatives 2 and 3: Acres of Rock Pits/ Percentage of Action Area
Gila trout	0/ 0%	0/ 0%
Gila chub critical habitat	0/ 0%	0/ 0%
Gila topminnow	0/ 0%	0/ 0%
Little Colorado spinedace	0/0%	103/ 0.05%
loach minnow critical habitat	0/ 0%	0/ 0%
spikedace	0/ 0%	0/ 0%
spikedace critical habitat	0/ 0%	0/ 0%
narrow-headed gartersnake	0/0%	0/ 0%
narrow-headed gartersnake critical habitat	0/ 0%	0/ 0%
Chiricahua leopard frog	0/ 0%	63/ 0.04%
Chiricahua leopard frog critical habitat	0/ 0%	63/ 0.06%
desert sucker	0/0%	5/ 0%
Little Colorado sucker	0/0%	104/ 0.05%
headwater chub	0/0%	5/ 0%
roundtail chub	0/ 0%	0/ 0%
northern leopard frog	0/ 0%	58/ 0.06%

Stream, Riparian, Wet Meadow, and Spring Restoration

The intent of this portion of the proposed action is to curb the loss or decline of wetland, riparian, or aquatic plant species and restore native and/or rare wetland, riparian, and aquatic plant species. Projects would be designed to protect or restore existing native biodiversity, aid in erosion control and restore soil function, or create wildlife forage and habitat. The actions include techniques that promote plant growth and vigor, reduce erosion and sediment inputs to aquatic systems, or removal of riparian or aquatic stressors such as ungulate grazing, OHV impacts, user created trails, and dispersed camping that may be causing resource damage to reduce erosion or aid in bank stability.

Riparian restoration, particularly in headwater meadows, would restore process that could benefit aquatic species by storing more water in riparian floodplains (Hunt et al. 2018) and increasing woody riparian canopy cover (where appropriate) (Wondzell et al. 2018) which should make cooler more abundant water available to the stream during dry periods. Additionally, riparian zones can function to improve water quality and change the sediment regime. In general, the proposed action is to restore the riparian functioning condition and attempt to mimic historic flows within the historic range throughout the watershed. Improving riparian vegetation is one way of improving the proper functioning condition.

Headwater meadows are areas where riparian vegetation can be improved to the benefit of riparian function, water flows and timing of water flows. Species composition in the headwater meadows should include sedges and rushes, due to their high root mass and vegetative density but can also include willow or alder in some systems. Removal of encroaching conifers will help reduce competition and improve vigor of riparian species. Vegetative density should be to the point where the bare ground is covered when high flows push down the plants. The species and height are important and can be tall plants or short plants (mat). Vegetation should be able to lay down the plants in the direction of the water flow and protect the bare ground. This would decrease eroding streambanks and help trap sediments, thus aggrading the site. Riparian vegetation treatment methods would occur within the riparian zones outside of the water so there would be no in stream disturbance to species within the water. Potential short and long-term effects of these treatments are described in table 71.

Table 71. Techniques that would be used for riparian restoration projects and potential effects to species

Action	Timeframe for Potential Effects	Potential Effects
Intent	Long term	Restoration of riparian vegetation will restore process that could benefit aquatic species by storing more water in riparian floodplains which should make cooler more abundant water available to the stream during dry periods. Additionally, improved riparian vegetation functions to improve water flows and change the sediment regime: In general, we would like to restore the riparian functioning condition and mimic historic flows within the historic range throughout the watershed. Improving riparian vegetation is one way of improving the proper functioning condition of certain riparian systems and includes an improvement in the species composition and the species density. Headwater meadows are areas where riparian vegetation can be improved to the benefit of riparian function, water flows and timing of water flows. Species composition in the headwater meadows should include sedges and rushes, due to their high root mass and vegetative density. Vegetative density should be to the point where the bare ground is covered when high flows push down the plants. The species and height are important and can be tall plants or short plants (mat). Vegetation should be able to lay down the plants in the direction of the water flow and protect the bare ground. This will decrease eroding streambanks and help trap sediments, thus aggrading the site.
Hand thinning	Short term	Hand riparian thinning is not likely to have measurable effects for species in stream systems. May have some temporary decrease in shade cover. Some potential for disturbance of frogs and gartersnakes.
Mechanical Thinning	Short term	Mechanical riparian thinning is not likely to have measurable negative effects to aquatic species within the stream systems unless there is ground disturbance. There may be some change in conifer shade cover which could increase stream temperature or change invertebrate abundance. There are design features to maintain stream shade (AQ032, AQ033-34, BT001). There is potential for trampling of frogs or gartersnakes or sedimentation from equipment or tree skidding but design features should minimize these.
Prescribed Fire	Short term	Potential for ash flow into streams, generally riparian vegetation recovers quickly in response to fire. Generally, no adverse effect from smoke to aquatic species unless enough ash is present to create water quality concerns. Potential for direct disturbance for gartersnakes and frogs when prescribed fires are conducted within riparian areas or dispersal areas but design features exist to reduce impacts.
Herbicides	Short term	Not analyzed here. Already covered in forest weed management planning documents.
Hand Planting	Short term	Limited potential for sedimentation where new vegetation is planted. Effects should be minimal, no noticeable effects to species. Riparian planting increases bank stability, shade, and organic matter inputs to streams improving stream habitat.
Mechanical Planting/ Seeding	Short term	Mechanical planting and seeding are not likely to have measurable adverse effects to aquatic species within the stream systems. May have some change in shade cover. Some potential for trampling of gartersnakes or sedimentation from equipment but design features should minimize these. Riparian planting increases bank stability, shade, and organic matter inputs to streams improving stream habitat.
Fencing Installation	Short term	Installation of fencing is not likely to have adverse effects species in stream systems. There is some potential for disturbance or trampling of frogs or gartersnakes if mechanized equipment is used.
Seasonal Restriction	Long term	Administrative action which should have long term positive effects to habitats for aquatic species by removing disturbance. May include timing restrictions for species needs or soil conditions.
Trail or Road Removal/ Relocation	Short term	There could be some potential for short term sedimentation from areas that are being rehabilitated or relocated. Effects include disturbance to gartersnakes and frogs or changes in sedimentation.
Trail Creation	Short term	Trails may be created in areas to minimize further resource damage. There could be some negative effects during construction, but design features should help minimize. Effects include disturbance to gartersnakes or changes in sedimentation.

Spring Restoration and Rehabilitation

Alternatives 2 and 3 include tools for rehabilitation of springs developed for irrigation or livestock that are no longer needed and is compatible with existing water rights. Projects designed to restore natural spring function and flow which would be beneficial in the long term for aquatic species. Problems addressed include drying of spring outflow, reduced aquatic and riparian vegetation, reduced habitat, reduced soil function, spring not functioning properly. Spring projects are varied but are mainly concentrated on improving the flow and vegetation around springs. Some of this work may occur within wetted areas and could potentially have short-term negative effects to species that inhabit the springs (table 72). There are multiple design features to minimize ground disturbance and impacts to these sensitive areas (SW014, SW018-19, SW045, SW070).

Table 72. Effects of techniques for improving spring outflows

Action	Timeframe for Potential Effects	Potential Effects
Intent	Long Term	Improved spring flow and habitat around springs and protection of habitat. Beneficial for aquatic species including leopard frogs. Remove unneeded channels to consolidate spring outflow and increase habitat or split flow in developed springs to allow water above existing water rights to be released to spring outflows
Improve or remove boxes or other infrastructure using hand methods for excavation such as shovels, or mechanical methods such as trackhoes, jackhammers, concrete saw to restore natural spring function.	Short term	Surface disturbance, including digging, filling, rock placement, etc. both with machinery or hand tools. If habitats are occupied by listed species there is the potential for direct effects such as trampling of Chiricahua leopard frogs and tadpoles and short-term effects from sedimentation from digging within wetted areas. Design features such as timing restrictions or salvage should minimize these potential effects.
Fencing installation	Short and long term	Protect spring emergence zone and/or springbrook from direct ungulate disturbance through fencing would be beneficial for aquatic species habitats. Will provide more options for livestock grazing management. Installation of fencing generally occurs outside of wetted areas and is unlikely to have direct negative effects to aquatic species.

Road Improvements

Proposed road projects include road relocation and decommissioning which includes restoring a road surface to a more natural state, as well as projects that improve the interaction of roads with stream channels. These would be designed to improve stream function and morphology. Short-term negative impacts to individuals and riparian condition would be similar to those discussed below for aquatic restoration. Direct impacts to individuals could occur for species in riparian or in stream habitats that interact with these roads.

There are long term benefits of reducing road density which can have a cascade of effects: improved riparian condition from reduction in runoff and sedimentation, fewer roads crossings, and the ability for riparian vegetation to be restored, and decreased mortality or disturbance of species. Road density is a major factor in the current condition of most subwatersheds with aquatic species in the project area. Reducing road density by decommissioning roads could help improve that particular Watershed Condition Framework indicator. Relocating and improving roads and stream crossings does not reduce overall road density, but can help alleviate direct versus indirect impacts, particularly if roads are moved further from a stream or riparian area.

Roads near drainages can have deleterious effects to the form and function of streams. The implementation of well-designed projects can improve these road stream interactions in cases where it is

not feasible to relocate roads that are causing damage, which could have positive long-term effects to species habitats. Relocated roads should be constructed in a manner that does not hydrologically connect them to streams to extent practicable. They would also have sufficient drainage features to maintain the integrity of the travel, thereby reducing erosion and sedimentation. New cross drains would discharge to stable areas where the outflow would quickly infiltrate the soil and not develop a channel to a stream. When feasible, relocate roads out of drainage bottoms to upland locations; if this is not possible rock armor outfall of drainage features to dissipate water energy. Multiple design features are associated with road decommissioning (SW045, SW062-64, TR08-09, TR011) and relocation (SW058, TR010-011) to reduce impacts.

Contaminants, aquatic invasive species or diseases can be introduced to aquatic systems from equipment causing negative impacts to aquatic species. Pollutants in the form of fuels and lubricants could be transported directly into streams from equipment or from stormwater runoff from staging areas or refueling areas. Typical water-quality responses to pollutants include altered levels of heavy metals, salinity, turbidity, and dissolved oxygen. These water quality changes can be sporadic and localized due to fluctuations in water quantity. However, there are six design features to prevent contaminants from entering riparian areas, waterbodies and aquatic habitats which minimizes the potential impact. These measures range from checking for leaks daily to refueling and staging areas being outside aquatic management zones (SW015-16, SW074). Aquatic invasive species or diseases could similarly be introduced to streams or waterbodies through transfer of mud or water. However, design features for decontamination of equipment (AQ001, AQ023, AQ028, AQ038) and not transferring water (AQ026), and using clean gravel (AQ031) are expected to reduce any potential introduction or spread of invasive species and disease.

Road restoration projects using techniques below should generally have long term positive effects for listed aquatic species as described below (table 73). These projects generally use large machinery and may include both instream work and work within the riparian areas. Short-term negative effects may include increased sedimentation, disturbance to individual species, or death of individuals for projects that require temporary dewatering.



Figure 85. Temporary berm to divert water from project area. Downcutting on stream below a low water crossing.

Table 73. Effects of techniques for improving road or trail interactions with stream courses, springs, or other wetlands

Problem Addressed/Intent	Action	Potential Effects
Intent	Decrease impacts of the road system to riparian and stream ecosystems. Minimize sediment input from roads and where possible allow stream geomorphology to follow natural progression. Provide for aquatic organism passage at road crossings unless barriers are desired for control of non-native species.	Positive - Projects should result in long term improvements to road impacts including decreased sedimentation, improved stream morphology process, and connectivity (where desired).
For existing roads causing resource damage such as confining a stream, draining wetlands, loss or degradation of riparian or aquatic vegetation and habitat, and loss or degradation to proper soil function.	Obliterate roads restoring natural contours and vegetation using mechanical roads treatments.	Potential displacement of individual species at project areas, temporary sediment plumes during construction. Areas that require dewatering may cause fish to be killed if they are not salvaged.
For unauthorized roads, trails or recreational impacts causing resource damage such as confining a stream, draining wetlands, loss or degradation of riparian or aquatic vegetation and habitat, and loss or degradation to proper soil function.	Decommission unauthorized roads, trails, and dispersed camping areas using mechanical roads treatments.	May have short term effects on all life stages of fish and amphibian species including prey species for gartersnakes or aquatic invertebrates which are prey for aquatic species. Eggs and larval stages are especially vulnerable.
Erosion, sedimentation, degradation or loss of vegetation from ML 1 roads.	Return ML 1 roads to closed status after use for restoration treatments by removal of drainage infrastructure (e.g., culverts), reestablishment of road drainage through leadout ditches, water bars, rolling dips, and other means, removal of unstable fill, and placement of slash using mechanical roads treatments.	Potential increase in sedimentation from opening and use of ML-1 roads. May result in short term decrease in shading or habitat for terrestrial invertebrates which are prey for aquatic species. There is a potential for machinery to introduce invasive species or pollutants. Best management practices and design criteria will minimize these risks.
Increased erosion and scouring downstream of culverts, bank instability, and channel downcutting.	Armor downstream culvert outlets using mechanical roads treatments.	Multiple design features are associated with road decommissioning (SW045, SW062-64, TR008-9, TR011) and relocation (SW058, TR010-11) to reduce impacts of sedimentation during and after road improvement projects.
Streams scouring around culverts and over roads, increased erosion to streams or wetlands, reduced aquatic organism passage from road culverts. Potential impacts to channel soil stability and site productivity.	Upsizing culverts using mechanical roads treatments.	
Loss of stream connectivity, channel width, erosion and sedimentation to streams, channelization and increased channel width due to roads. Potential impacts to channel soil stability and site productivity.	Installing or adding culverts or culvert arrays using mechanical roads treatments.	
Decreased fish passage, habitat access, passage of high flows and bedload, and decreased channel complexity from road culverts.	Maintaining Aquatic Organism Passage where it exists if road work needed. – Install bridge, replace culvert, or remove crossing using mechanical roads treatments.	
Loss or degradation of riparian vegetation or soil function, channel widening, increased erosion, sedimentation to aquatic habitats, increased bank instability from roads crossing streams or wetlands.	Install hardened low water crossings or fords (rock, concrete slab, concrete planks, concrete blocks, geocell fords, and vented fords on existing ML 1 and ML2 roads needed for mechanical offerings using mechanical roads treatments.	

Problem Addressed/Intent	Action	Potential Effects
Decreased aquatic and wildlife passage through culverts or under existing bridges, deposition of stream bedload upstream of culverts, high flows are scouring channel and floodplain upstream, log jams are forming upstream of culverts or bridges.	Install and replace bridges on ML1 and ML2 roads needed for mechanical offerings using mechanical roads treatments.	
Restore natural flow paths and connection of flow to floodplain areas.	Raise culverts where invert elevations have resulted in stream incision.	
Restore natural flow paths.	Install raised permeable roadbeds with or without culverts where roads cross areas of seasonal or perennial water inundation.	
Channel widening, erosion and sedimentation upstream or downstream of a road crossing. Loss or degradation of riparian vegetation and soil function.	Restore channels affected by road crossings using mechanical roads treatments.	
Reduce sedimentation and erosion, improve vegetation and soil condition, restore stream banks, restore and improve aquatic and terrestrial habitat.	Decommission or relocate ML1 and ML2 roads needed for mechanical offerings causing resource damage to springs, wetlands or streams using mechanical roads treatments.	
Streams, springs, or wetlands have increased sedimentation, increased erosion, and loss or degraded vegetation and soil condition from user created trails.	Developing footpath(s) on existing trails to prevent further erosion using hand or mechanical treatments.	

Stream Restoration

General stream treatments include methods that could either be implemented by hand or using machinery such as driving a vehicle to a site, pneumatic post pounder, or gas-powered auger. Heavy mechanical treatments are those that require machinery such as a trackhoe or front-end loader. Both implementation types could have effects to aquatic species. These methods generally occur within the stream channel and floodplains. Projects utilizing heavy machinery are likely to be larger in scope than those utilizing only hand methods. In addition, there is often a temporal difference in the realization of positive effects from the various methods. Though disturbance may be initially higher with heavy machinery, project effects are often less noticeable soon after the project is completed. Projects that utilize hand methods often take a more natural approach and require several seasons of flow events or vegetation growth to produce measurable improvements to habitats.

Though the long-term effects of stream restoration projects are anticipated to be positive for species, some actions may result in a degree of short-term negative effects to aquatic species and their habitats. Short term effects to generally include disturbance within the streams and nearby floodplains which may result in sediment plumes while work is occurring or during storm events, temporary disturbance of occupied habitats and displacement of individuals, temporary reduction of riparian vegetation cover in the project area and change of channel structure. These impacts are considered short-term (a few weeks) and sediment should be moved downstream during the first high stream flow. Beneficial impacts of general stream treatments can be immediate and long-term. The response to projects such as headcut stabilization may have an immediate impact of improving stream function and restoring fish passage upstream. Potential effects for each suite of methods analyzed are summarized in table 74 below.

Multiple project design features are included in the project to reduce adverse impacts where feasible given the nature of these methods. Reducing heavy equipment impacts are addressed in AQ008, AQ011,

AQ030, SW063, SW065-68, SW070, to reduce direct impacts and sedimentation. Reducing impacts to riparian vegetation is covered by AQ014, AQ035, AQ037, SI001, SI003, SI023, and SW008-9 while protecting stream shade is included in AQ032-34. There also design features for site rehabilitation (SW059-63) and stockpiling materials from uplands for use in streams (SI007).

Table 74. Effects of techniques for improving the form and function of stream channels and floodplains

Problem addressed/Intent	Action	Potential effects
Intent	Long Term- Restoration of stream and floodplains to restore process could benefit aquatic species by improving habitats and storing more water in riparian floodplains and improving groundwater availability to stream flow. Streams more connected to groundwater tend to less affected by air temperature and have more abundant water available during dry periods (Norman et al. 2016). In addition, in many areas of the project area, streams lack the habitat diversity needed to support all life stages of listed aquatic species. Restoration projects will be designed to provide long term beneficial effects to species habitats by restoring ecological function. In some areas, projects will be designed that will improve habitat for recreational native and nonnative sport fish as well. Managers will need to examine the potential for projects to change the dynamics between native and non-native aquatic species in order to minimize negative fish community effects.	
Techniques proposed for heavy mechanical restoration of channels and floodplains.	Boulder and log deflectors using mechanized installation.	Effects include short-term displacement of individuals in project areas and temporary sediment plumes during construction. Areas that require dewatering may cause fish to be killed if they are not salvaged.
	Restoring meanders or adding stream length by induced meandering, recontouring the channel, plug and pond, other similar methods mechanically.	Activities may also result in short-term increases in sedimentation from activities with surface disturbance. Could have negative effects especially to fish and tadpoles. May cause short-term negative effects to species habitats by increasing embeddedness of substrate or filling in low velocity habitats that are crucial for larval fish, hunting gartersnakes, and developing frogs. Increased embeddedness can cause a temporary decrease in aquatic invertebrates and fish prey base.
	Channel reconstruction, realignment or floodplain reconnection using mechanical treatments.	Design features will help decrease these negative effects both during and post construction.
	Flood plain creation, widening, or laying back incised stream banks using mechanical treatments.	
	Removing instream stock tanks and replacing with guzzlers, drinkers, etc. in the uplands using mechanical treatments	
	Reconnection of historic side channels that should be functioning using mechanical treatments.	
	Large woody debris, log structures, log jams, yarding trees. Tree falling, transport and placement of trees and root wads from somewhere else, yarding over trees, helicopter wood, mechanical installation.	
Techniques proposed for either mechanical or hand restoration of channels and floodplains.	Weirs and Beaver Dam Analogs (BDAs) installed by hand or mechanical methods.	Effects include short-term displacement of individuals at project areas, temporary sediment plumes during construction.
	Wicker, log and rock weirs, vanes, or baffles, brush bundles and root wads using various methods and installed by hand or mechanically.	Effects may also result in short-term increases in sedimentation during activities with surface disturbance. These effects are expected to be immeasurable and persist until the high flow even occurs. Could have negative effects especially to fish species and tadpoles as well as hunting ability for gartersnakes. May cause negative effects to species habitats by increasing short-term embeddedness of substrate or filling in low velocity habitats that are crucial for larval fish and developing frogs until after a high flow even occurs. May also cause a temporary decrease in aquatic invertebrates and fish which are prey for gartersnakes.
	Zuni bowls, one rock dams or other similar methods using mechanical or hand treatments.	
	Maintenance of existing structures using manual or mechanical treatments.	
	Removing existing erosion control structures by hand or mechanically.	
Techniques for hand restoration of channels and floodplains.	Hand girdling trees to provide for future large woody debris stream input.	No effect from girdling. Potential positive effect for future habitat conditions.

Summary of Magnitude of Effects of General and Heavy Mechanical Riparian, Spring, and Stream Restoration on Listed Aquatic Species.

Due to the large area, it is unlikely that restoration will occur in all the acres and stream miles that are being proposed for riparian, spring and stream restoration. In the past only a few projects per year have been implemented. The pace and scale of restoration may be increased from previous years since much of the compliance paperwork will be accomplished with this project. Stream restoration treatments are proposed for areas occupied by all of the species within the project area (table 75). There are no stream treatments proposed in habitats for the five species or critical habitat occurring outside the project area and none with proposed within Chiricahua leopard frog critical habitat so no effects are expected to occur from proposed treatments. Long-term benefits of the restoration are expected to outweigh the short-term negative impacts, but it will be important to monitor projects affecting a given species or population to ensure that viability is not negatively affected.

Benefits from mechanical restoration can be immediate and long-term by improving or restoring riparian condition via one of the following: spring condition, stream structure/complexity, stream sinuosity and length, bank stability, floodplain connectivity. Such results will promote conditions that maintain or decrease stream temperature, reduce turbidity (via stable banks, improved sediment retention through increased channel structure, riparian areas, and floodplains), and improved nutrient input (via increases riparian organic input sources) and retention (via increased channel structure, sinuosity, and floodplain areas). It is anticipated that project related sediment will be flushed out during the first spring high flows after project completion, and site restoration conservation measures are expected to prevent future project related sediment inputs into the stream. Therefore, long-term sediment impacts to sediment and turbidity are not expected. General stream restoration methods that are implemented with hand tools generally have a smaller footprint and less disturbance, but the positive impacts may be more subtle and take a little longer to realize.

Both general and heavy mechanical stream treatments could have negative effects to aquatic indicators. These treatments inherently include short term disturbance in streams, their floodplains, and associated riparian areas in order to improve form and function. For all project types in and near riparian, spring and stream habitats there is a risk of short-term effects to individuals or their habitat from implementation of projects both under general and heavy mechanical restoration. The most likely effects would be from harm or disturbance from the use of heavy equipment around streams, springs and wetlands, temporary stream dewatering if necessary for project implementation, or sediment plumes decreasing water quality. These risks are lower with hand methods due to the mobility of species giving them a high likelihood of moving out of the project area and generally smaller project footprints. Conservation measures to look for and move gartersnakes away from construction zones in occupied areas could be implemented as needed. Similarly, fish could be removed or isolated from instream construction areas during in water work periods to minimize the potential for effects.

Other effects may include temporary decreases in riparian condition, increased sedimentation, and the potential for introduction of contaminants or spreading of aquatic invasive species or disease. There may be short term impacts to prey species such as native fish or aquatic invertebrates which could occur during or shortly after project implementation. In water work periods will be determined on a project specific basis and jointly by Forest Service, U.S. Fish and Wildlife Service and Arizona Game and Fish Department due to the overlapping of federally listed and sensitive species. Instream work timing would be prioritized by listed species present and factors such as spawning/breeding seasons or activity periods. Project level best management practices and mitigations would minimize the potential for introduction of contaminants or spread of aquatic invasive species or disease.

Table 75. Miles of general and heavy mechanical stream restoration for alternatives 2 and 3 as compared to alternative 1. Percentages reflect changes in acreages within species analysis areas.

Species	Alternative 1	Alternatives 2 & 3: General Stream Treatment Miles/ Percentage of Action Area	Alternatives 2 & 3: Heavy Mechanical Stream Treatment Miles/ Percentage of Project Area
Gila trout	0	8/ 24%	4/ 13%
Gila chub and critical habitat	0	0/ 0%	0/ 0%
Gila topminnow	0	0/ 0%	0/ 0%
Little Colorado spinedace	0	113/ 86%	11/ 9%
Little Colorado spinedace critical habitat	0	31/ 93%	2/ 7%
loach minnow critical habitat	0	0/ 0%	0/ 0%
spikedace	0	0/ 0%	0/ 0%
spikedace critical habitat	0	0/ 0%	0/ 0%
narrow-headed gartersnake	0	7/ 47%	3/ 23%
narrow-headed gartersnake critical habitat	0	8/ 85%	4/ 40%
Chiricahua leopard frog	0	19/ 7%	14/ 5%
Chiricahua leopard frog critical habitat	0	0/ 0%	0/ 0%
desert sucker	0	52/ 49%	18/ 17%
Sonoran sucker	0	5/ 40%	3/ 26%
Little Colorado sucker	0	101/ 69%	8/ 6%
headwater chub	0	11/ 23%	7/ 14%
roundtail chub	0	4/ 27%	2/ 18%
northern leopard frog	0	42/ 30%	29/ 21%

While introduction of contaminants, aquatic invasive species or diseases into streams from large equipment could occur, project design features are expected to eliminate the possibility. Best management practices and conservation measures requiring cleaning equipment, checking for leaks, and storage of fuels and staging areas for equipment outside of aquatic management zones minimizes or precludes the likelihood of contaminants occurring. Similarly, the risk of chytrid fungus or aquatic invasive species being spread by both machinery and hand equipment will be minimized by requiring decontamination procedures to be followed when activities take place within wetted areas or the moist perimeter of a tank or ephemeral stream and then immediately moving to another wetted area (AQ001, AQ023, AQ028). Given all the mitigations, adverse effects from introduction or spread of contaminants, aquatic invasive species or disease is not expected to occur.

Riparian condition could be negatively impacted by short-term inputs of increased sedimentation from instream structure placement, opening of side channels, road crossing treatments, and other projects inside or near the bankfull channel. The sediment plume from activities will be most concentrated in the immediate project vicinity and should dissipate throughout the stream channel within a few hours. The amount, extent, and duration of fine sediment inputs and turbidity relate to the following: the type and duration of heavy machinery used within or near a bankfull channel; soil type; the amount of soil disturbance; whether restoration is in or out of the wetted channel; the sensitivity of the channel banks to erosion and other disturbances; the amount of time it takes for disturbed areas to revegetate and stabilize; and the probability of precipitation events before disturbed areas are re-vegetated or stabilized (AQ006, AQ008, AQ031).

The increased stream turbidity may deposit fine sediment a short distance downstream, encourage fish and other aquatic species to move downstream, and alter fish behavior patterns for a short time. It is

anticipated that project related sediment will be flushed out during the first fall/winter/spring high flows after project completion, and site restoration conservation measures are expected to prevent future project related sediment inputs into the stream. Therefore, long-term negative impacts to substrate embeddedness are not expected.

First and second order streams are the sources of water, nutrients, woods, another vegetative material for streams inhabited by fish and other aquatic organisms. Fish passage culvert projects, headcut stabilization and Associated Fish Passage, and Legacy Structure Removal treatments would result in benefits such as uninhibited stream access for migrating and rearing fish, restored or improved continuous paths for wood, nutrients, sediments, and other vegetative material essential for quality fish habitat.

Where stream flow needs to be diverted for instream work, coffer dams and bypass systems associated with heavy mechanical restoration activities may temporarily block (few days) fish movement up and/or downstream through the instream work area. During project implementation, there may be short-term negative impacts by temporarily restricting habitat or habitat access (displacement) within stream work areas. Fish would be blocked from work areas using block nets. Up and downstream fish movement is possible in ditch bypass systems, downstream movement with plastic-culvert bypass systems, but no fish movement is provided with pump bypass systems. Headcuts and existing structures to be repaired or removed may be acting as existing fish-passage barriers; therefore, temporary coffer dams, culverts, and diversion structures may not present additional barriers than the pre-restoration baseline.

The use of upland soil restoration structures (such as Zuni bowls or native rock check dams) to address site specific erosion/channelization resource issues within project watersheds is unlikely to have negative effects on aquatic species. The number that may be installed would vary based on watershed needs. These structures would have a long-term benefit of reducing erosion and sedimentation to stream by holding and stabilizing soils in the uplands and improving hydrologic condition and function. Riparian and rare plant planting and the installation of enclosures to protect existing or planted areas could occur where site-specific needs are identified in riparian areas, wet meadows, springs, and uplands areas such as where aspen or big-toothed maple occur. The establishment and protection of riparian plants along streams can improve bank stability, stream shading, and aquatic habitat.

Aquatic Macroinvertebrates

Stoneflies, caddisflies, mayflies, midges, and riffle beetles are strongly associated with streams and riparian areas. Based on the biology and ecology of these four groups of species, stream and watershed restoration in accordance with the aquatic and watershed condition-based management could have both positive and negative impacts to aquatic macroinvertebrates. Direct impacts to individuals and their habitats could occur short-term during project implementation. General stream treatments would have a low potential for direct and indirect impacts to these sensitive species given the methods included (such as fencing, planting). Heavy mechanical stream treatments have the potential for more direct effects as they include short-term habitat alteration in streams and riparian areas that could also impact individuals. Indirect effects of sedimentation from restoration treatments would last as long as the first few flushing flow events. Beneficial effects would occur from improved stream habitats and riparian vegetation long term.

Nokomis fritillary is a sensitive species that utilizes meadows, seeps, and boggy streamside vegetation. General stream treatments would have a low potential for negative impacts to the species. Heavy mechanical stream treatments could have direct and indirect impacts. Short-term negative impacts to individuals and their habitat could occur during implementation. Indirect effects of habitat alteration would last until vegetation was restored or had regrown that supports the species. Beneficial effects would occur from improved stream-riparian interaction and riparian habitat.

For California gopher, general stream restoration treatments would have a low potential for direct or indirect impacts. Fencing across streams could impact individuals but is unlikely. Indirect impacts of sedimentation from these methods would also be considered negligible. Heavy mechanical stream treatments are proposed in Upper Clear Creek (49 miles) and West Clear Creek (2.9 miles) where the species historically or currently occurs. Short-term negative impacts to individual could occur during implementation of instream treatments. Indirect impacts of sedimentation are expected to persist until the first few flushing flows mobilize any sedimentation downstream. Beneficial effects would occur from improved stream habitats long term.

For all sensitive aquatic macroinvertebrates and management indicator species, streams and riparian areas could have short-term negative indirect impacts from proposed stream restoration as part of alternatives 2 and 3. Short-term indirect effects of heavy mechanical stream restoration include increased sedimentation, turbidity, introduction of contaminants, and spreading of aquatic invasive species or disease during project implementation. Indirect impacts of sedimentation are expected to persist until first few flushing flows mobilize any sedimentation downstream. Beneficial effects would occur from improved stream habitats long term.

Mechanical Vegetation Treatments

Mechanical vegetation treatments, including cable operations have the potential for negative short-term impacts to riparian condition and individuals where these activities occur in a species habitat. Alternative 2 is proposing treatments within eleven species habitats. Acres of mechanical vegetation treatments under alternative 2 ranges from 2 to 12,616 acres within species habitat which equates to 26 percent to 83 percent of the species habitats within the project area. Acres mechanically treated within species habitats is slightly reduced under alternative 3 for the same eleven species or critical habitats. Five fish species or critical habitats would not be impacted by mechanical vegetation treatments under alternative 2 or 3. Table 76 displays this information for each species.

Chamberlin et al. (1991) reviewed literature on timber harvest and watershed processes, which are relative to potential impacts to riparian condition. Mechanical vegetation treatments can increase erosion, sedimentation, and alter peak streamflows via removal of vegetation and ground disturbance. Mechanical thinning can influence both upland erosional processes and the way that streams process sediment in their channels. The potential for surface erosion is related to the amount of bare compacted soil exposed to rainfall and runoff. If soil infiltration is sufficiently reduced, water runs off rather than through soil resulting in higher peak flows and increased sediment transport. Therefore, features such as landings and skid trails can contribute large quantities of fine sediment and runoff to stream channels. Patterns of yarding and skidding can alter drainage paths and redirect water onto areas more likely to erode than natural channels. In addition to influencing soil structure, mechanical harvest can influence snow accumulation and melt rates as well as evapotranspiration and soil water which can also alter peak flows.

Table 76. Change by species in the acres of mechanical vegetation treatments for alternatives 2 and 3 as compared to alternative 1. Percentages reflect increases in acreage within direct effects analysis areas for species.

Species	Alternative 1: Acres of Mechanical Vegetation Treatment Acres	Alternative 2: Acres of Mechanical Vegetation Treatment Acres/ Percentage of Direct Effects Area	Alternative 3: Acres of Mechanical Vegetation Treatment Acres/ Percentage of Direct Effects Area
Gila trout	0	839/ 51%	805/ 49%
Gila chub and critical habitat	0	0/ 0%	0/ 0%
Gila topminnow	0	0/ 0%	0/ 0%
Little Colorado spinedace	0	2,198/38%	2,135/ 37%
Little Colorado spinedace critical habitat	0	102/ 78%	102/ 78%
loach minnow critical habitat	0	0/ 0%	0/ 0%
spikedace	0	0/ 0%	0/ 0%
spikedace critical habitat	0	0/ 0%	0/ 0%
narrow-headed gartersnake	0	521/ 85%	443/ 72%
narrow-headed gartersnake critical habitat	0	227/87%	227/ 87%
Chiricahua leopard frog	0	12,616/ 83%	10,118/ 66%
Chiricahua leopard frog critical habitat	0	2/100%	2/100%
desert sucker	0	2,463/ 36%	2,401/ 35%
Sonoran sucker	0	369/ 36%	364/ 41%
Little Colorado sucker	0	2,264/ 36%	2,151/ 35%
headwater chub	0	1,139/ 54	1,081/ 51%
roundtail chub	0	1,046/ 84%	911/ 73%
northern leopard frog	0	2,812/ 53%	2,113/ 39%

Mechanical vegetation treatments can negatively impact riparian condition short-term particularly when they occur within species habitats. Reduced riparian vegetation cover or structure could occur by removal of trees or crushed by machinery. This can decrease hiding cover and vegetation structure to frog and gartersnake critical habitat as well as habitat for some aquatic macroinvertebrates species (such as *Nokomis fritillary*). Indirect impacts of increased stream temperature from loss of canopy cover could occur, but should be limited based on design features associated with providing for and protection of existing stream shade. Indirect impacts of ground disturbance and increased sediment delivery to streams is expected to occur short to mid-term until ground cover is reestablished. Stream banks can also be damaged, which are primary constituent element for some fish, however design features for mechanical vegetation treatments including restrictions for skid trails and yarding within riparian areas as well as protecting stream banks would minimize potential impacts. Riparian condition for the narrow-headed gartersnake, desert sucker and Sonoran sucker are currently impaired, therefore, effects are expected to be more likely. Vegetation in these systems is not adequate to capture sediment, are often disconnected from the water table and are more reflective of upland species. Riparian condition for the remaining species is functioning at risk, therefore direct and indirect effects are expected to be less because vegetation should capture sediment. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and functioning at some level.

Impacts to individuals in the form of harm or modification of behavior could also occur short-term during implementation. Mechanical vegetation treatments within frog and gartersnake habitat could result in harm of individuals.

Frogs and gartersnakes may avoid or move out of these areas while work is occurring causing displacement or disruption of social and feeding behavior. There is a design feature to reduce harm to individual frogs during monsoon season when they are more likely dispersing. These effects have the potential to reduce the health or reproductive capability of individuals.

Long term, mechanical vegetation treatments could have a neutral or positive effect on aquatic indicators. Riparian condition could be improved by removing encroachment and restoring streamside vegetation. Conifers can impede the growth the riparian woody and herbaceous species; therefore, it is expected they would increase in cover and structure. This would provide for large woody debris over time as well as decreasing sediment delivery and peak flows. Impacts to individuals would cease once activities were completed and therefore have a neutral effect long term.

For alternatives 2 and 3, increased acres of mechanical vegetation treatments also has the potential for indirect occur short-term impacts riparian condition from treatments in the upper watershed. These are indirect impacts that can occur within a species action area (project watershed area that drains into a species occupied habitat) by changes in the uplands and on tributaries and drainages. Increases in percent of action areas treated under alternative 2 range from 54 percent to 94 percent. Table 77 displays these species habitats as compared to the existing condition (alternative 1).

Table 77. Change by species in acres of mechanical vegetation treatments for alternatives 2 and 3 as compared to alternative 1. Percentages reflect increases in acreage within species analysis areas. These are considered indirect impacts.

Species*	Alternative 1: Acres of Mechanical Vegetation Treatment Acres	Alternative 2: Mechanical Vegetation Treatment Acres/ Percentage of Action Area	Alternative 3: Mechanical Vegetation Treatment Acres/ Percentage of Action Area
Gila trout	0	90,268/ 82%	72,446/ 66%
Gila chub* and critical habitat	0	12,325/ 57%	2,489/ 11%
Gila topminnow*	0	11,628/ 94%	1,327/ 11%
Little Colorado spinedace	0	118,974/ 58%	90,487/ 44%
Little Colorado spinedace critical habitat	0	33,275/ 49%	29,718/ 44%
loach minnow critical habitat	0	11,628/ 94%	1,327/ 11%
spikedace*	0	11,628/ 94%	1,327/ 11%
spikedace critical habitat*	0	16,075/ 90%	2,514/ 14%
narrow-headed gartersnake	0	31,303/ 67%	25,028/ 53%
narrow-headed gartersnake critical habitat	0	31,602/ 68%	25,327/ 54%
Chiricahua leopard frog	0	88,853/ 74%	76,375/ 63%
Chiricahua leopard frog Critical Habitat	0	8,652/ 98%	8,434/ 96%
desert sucker	0	206,464/ 65%	167,754/ 53%
Sonoran sucker	0	37,607/ 72%	30,603/ 59%
Little Colorado sucker	0	123,384/ 55%	96,618/ 43%
headwater chub	0	119,881/ 81%	96,358/ 65%
roundtail chub	0	124,002/ 77%	83,819/ 52%
northern leopard frog	0	20,446/ 48%	13,097/ 31%

*While the percentage is high for these species action areas, less than half of entire watershed is within the project area.

Mechanical vegetation treatments in uplands can indirectly impact riparian condition short-term from increased sediment delivery and peak flows via removal of vegetation and ground disturbance. Soils can be compacted and water infiltration reduced from landings and skid trails leading to increased overland flow and erosion. Yarding and skidding can redirect water onto areas more likely to erode than natural

channels. In turn, increased sedimentation and peak flows can occur reducing riparian condition, aquatic habitat quality and quantity.

Riparian condition for the narrow-headed gartersnake, desert sucker and Sonoran sucker are currently impaired therefore indirect effects are expected to be higher. Vegetation in these systems is not adequate to capture or process sediment, indicating more would reach streams. These riparian areas are often disconnected from the water table and are more reflective of upland species; therefore, likely unable to dissipate stream energy associated with increased peak flows. Riparian condition for five species is currently functioning at risk therefore indirect effects are expected to be less. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and able to process sediment and dissipate flows in a limited capacity. Riparian condition for the remaining four species in Upper Fossil Creek is functioning properly. While indirect effects could occur, these riparian areas are able to process sediment and dissipate flows.

For those species with poor or fair riparian condition, elevated sedimentation could negatively impact aquatic habitat, species, and water quality; particularly fish eggs and early life history stages that occur on or within substrate as well as the aquatic macroinvertebrate community structure. Habitat is impacted by filling of pools and spawning substrates which can lead to loss of habitat quality and reduced reproductive success. Peak flows can be increased altering channel forming flows leading to bank erosion and loss of habitat complexity. Reduction in riparian vegetation can lead to decreased organic matter input to support aquatic macroinvertebrates and increases stream temperature.

Design features related to mechanical vegetation treatments are expected to minimize the potential effects described above. The project includes spreading treatments in time and space within a watershed (SW054) as well as for skid trails (SW020-21, SW28, SW030, SW032-33, SW041, SW046), yarding (SW036), and landings (SW038, SW047) are expected to reduce effects. The project also includes a design feature to protect herbaceous regrowth post-treatment from livestock grazing if necessary (RM004, SW012).

Pollutants in the form of fuels and lubricants have the potential to be introduced into aquatic systems from staging areas and equipment. Spills and leaks can introduce pollutants to soils and then to streams and riparian areas reducing riparian condition and habitat quality. However, there are four design features to prevent contaminants from entering riparian areas, waterbodies and aquatic habitats which minimizes the potential effects. These measures range from checking for leaks daily to refueling and staging areas being outside aquatic management zones (AQ003, SW015-16, SW074).

Long term, mechanical vegetation treatments are expected to improve overall watershed condition as well as riparian condition. Moving forests toward desired conditions of more a healthy, resilient state would provide for improved watershed function over time. It would also reduce the risk of uncharacteristic wildfire which can greatly impact all resource indicators and reduce aquatic habitat quality, quantity and populations. Alternative 2 would have more long-term improvements to riparian condition than alternatives 1 and 3 due to the increased overall acreage.

In summary, negative effects from mechanical vegetation treatments within species habitats would be similar for alternatives 2 and 3. Alternative 2 has greater potential for negative effects within species action areas than alternative 3, but also has the most potential for long term benefits.

Prescribed Burning

Prescribed burning proposed in alternatives 2 and 3 has the potential for negative short -term impacts to riparian condition and harm to individuals when it occurs within species habitat. Alternative 2 is proposing treatments in the habitats of thirteen aquatic species or critical habitats (table 78). Prescribed

burning treatments range from 2 to 13,974 acres which equates to 40 percent to 100 percent of habitat for those species under alternative 2. Alternative 3 proposes slightly fewer prescribed burn acres for the same thirteen species or critical habitats, except for roundtail chub and northern leopard. For those two species, 30 to 38 percent less of their habitat would be impacted under alternative 3 as compared to alternative 2. Three species or associated critical habitat have no prescribed burning proposed within their habitat under alternatives 2 or 3 and therefore no negative effects.

Response of riparian condition and aquatic ecosystems to fire can be highly variable and dependent on fire attributes (such as severity, intensity, fire size), magnitude of subsequent storms and snowmelt events, amount of the watershed burned, stream size, and topography (Gresswell 1999, Dwire and Kauffman 2003, Vieira et al. 2004). Indirect fire impacts can consist of altered peak flows and hydrologic processes (Minshall et al. 2003), hillslope erosion and stream sedimentation (Swanson 1981; Megahan 1991; Rinne 1996, Benda et al. 2003, Bisson et al. 2003), disrupted nutrient cycling (Swanson 1981; Megahan 1991; Bozek and Young 1994), loss of streambank vegetation leading to increased stream temperatures (Minshall et al. 2001, Minshall et al. 2003), decreased large woody debris, and fragmented aquatic habitat dynamics (Minshall et al. 2003; Rieman and Clayton 1997; Swanson 1981; Megahan 1991; Bozek and Young 1994). Adverse changes in these attributes can negatively impact riparian condition, as well as aquatic habitat quality and quantity.

Fire-related erosion and sedimentation can occur chronically (fine sediment delivery over long periods) or episodically (post-fire ash or sediment pulses, landslides and debris flows) (Dunham et al. 2003). Levels above what a riparian areas and stream can process, based on condition, can lead to negative effects to aquatic habitat quality and quantity. Large increases in sediment can lower pool density, reduce intragravel dissolved oxygen and circulation leading to loss of fish eggs, cover and food sources for benthic macroinvertebrates, and reduce the efficiency of filter feeding macroinvertebrates.

Treatments in riparian areas change the vegetative structure, canopy cover, and reduce fuel continuity. This can potentially lead to increased stream temperatures, reduced bank stability, and reduced organic matter (allochthonous material) reaching the stream (Dwire et al. 2016). Reduced fuel continuity provides for resiliency of riparian areas during wildfires by potentially reducing fire intensity and severity. In general, effects of spring or fall prescribed burning on both upland and riparian species composition appear to be either negligible or similar in effects of low-severity wildfire and are generally neutral or beneficial (Dwire et al. 2016). There are indications that the effects of prescribed fires are much smaller and shorter-lived to the effects of wildfire.

Fire regimes in riparian areas relative to adjacent uplands vary. In drier areas, similar to the project area, historical fire frequencies in uplands and riparian areas are often comparable (Dwire et al. 2016). Dry ponderosa pine/Douglas-fir forest of central Idaho had similar fire return intervals for upland and riparian stands. Where the vegetation composition of riparian areas is similar to adjacent uplands, streamside areas are likely to burn as frequently as the surrounding uplands. Therefore, the suppression of fires for decades has likely altered riparian areas and made them more susceptible to uncharacteristic wildfire similar to uplands.

Prescribed burning can negatively impact riparian condition short-term when it occurs in species habitats. Riparian vegetation cover or structure can be decreased as can existing large woody debris. Decreases in willows and other shrubby species reduces hiding and thermal cover for frogs and gartersnakes. This would also impact frog and gartersnake critical habitat as well as potentially impacting some aquatic macroinvertebrate species (Nokomis fritillary) (Earl and Blinn 1999, 2003). This reduction is only expected to occur until vegetation recovers. Reduction in canopy cover also reduces stream shading and can increase stream temperatures. It also reduces organic matter inputs to streams which can alter food webs and prey base for fish and gartersnakes. Indirect impacts of increased stream temperature from loss

of canopy cover could also occur but should be limited based on design features associated with limiting high burn severity (mortality) and ignitions within riparian areas.

Riparian condition for Little Colorado spinedace, desert sucker and Sonoran sucker is currently impaired, therefore negative effects are expected to be higher. Vegetation in these systems is not adequate to capture sediment, are often disconnected from the water table and are more reflective of upland species. They already lack adequate streamside cover and structure; therefore, those factors could be more susceptible to impacts. Riparian condition for the remaining species is functioning at risk, therefore negative effects are expected to be less as they have more cover and structure. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and functioning at some level.

Long term effects of prescribed burning are expected to be positive for riparian condition. Fire plays an important role in maintaining heterogeneity (riparian condition) in aquatic habitats (Gresswell 1999). Periodic variations in the influx of sediment and coarse woody debris from riparian areas to the active stream channel contribute to aquatic habitat heterogeneity by creating complex stream morphology and can be reflected in a diverse fish community (Reeves et al. 1995; Rieman and Clayton 1997; Gresswell 1999; Rieman et al. 2003; Robinson et al. 2005). Reduced fuel loading would protect these areas from uncharacteristic wildfire in the future and impacts of ash flows, altered flows and channel morphology.

Impacts to individual frogs and gartersnakes in the form of mortality or modification of behavior could also occur short-term. Mortality could occur during prescribed burning; however, frogs and gartersnakes are mobile and design features of no burn piles within their habitat is expected to reduce that potential. While frogs and gartersnakes are more susceptible to exposure during a prescribed fire, it is more likely that harm or displacement would occur until the burns were completed. Long term impacts to individuals would be neutral or potentially positive if habitat improved and similarly increased social or feeding behavior.

Table 78. Affected acres by species and the percent of change in the acres of prescribed burning for all alternatives. Percentages reflect changes in acreages within species direct effects analysis areas.

Species	Alternative 1: Acres of Prescribed burning	Alternative 2: Acres of Prescribed Burning/ Percent of Direct Effect Area	Alternative 3: Acres of Prescribed Burning/ Percent of Direct Effect Area
Gila trout	0	926/ 57%	892/ 55%
Gila chub and critical habitat	0	0/ 0%	0/ 0%
Gila topminnow	0	0/ 0%	0/ 0%
Little Colorado spinedace	0	3,881/ 66%	3,760/ 64%
Little Colorado spinedace critical habitat	0	114/ 87%	114/ 87%
loach minnow critical habitat	0	0/ 0%	0/ 0%
spikedace	0	0/ 0%	0/ 0%
spikedace critical habitat	0	0/ 0%	0/ 0%
narrow-headed gartersnake	0	548/ 89%	457/ 74%
narrow-headed gartersnake critical habitat	0	233/ 89%	233/ 89%
Chiricahua leopard frog	0	13,974/ 91%	11,018/ 72%
Chiricahua leopard frog critical habitat	0	2/ 100%	2/100%
desert sucker	0	2,823/ 41%	2,753/ 40%
Sonoran sucker	0	368/ 41%	375/ 42%
Little Colorado sucker	0	4,280/ 69%	4,106/ 66%
headwater chub	0	1,259/ 59%	1,196/ 56%
roundtail chub	0	1,156/ 93%	1,012/ 81%
northern leopard frog	0	3,841/ 72%	2,285/ 43%

Prescribed burning in species action areas (subwatersheds) can indirectly impact riparian condition short-term from increased sediment delivery and peak flows for all analyzed species. For alternative 2, the 11,990 to 245,367 acres of species or critical habitat action areas may be treated with prescribed fire (57 percent to 99 percent). Alternative 3 proposes fewer acres of burning with 1,327 to 194,037 acres of species action areas that may be treated with prescribed fire. Table 79 displays acres of prescribed burning in species or critical habitat action areas for all alternatives. However, while five species or associated critical habitat (denoted with an asterisk) show increases in acres treated, it is important to note the overall acreage is small for both action alternatives. This is due to less than half of subwatershed action areas occurring within the project boundary and thus less likelihood of impacts. Therefore, while the percent increase is large, the overall potential acres of impacts are much smaller than all other species. Overall impacts would be highest for desert sucker, Little Colorado sucker with the largest potential treatment acres and lowest for Gila topminnow, loach minnow critical habitat, and spikedace or its critical habitat for both alternatives.

Prescribed burning can indirectly impact riparian condition short-term from increased sediment delivery and altered peak flows. Loss of ground cover from burning can increase erosion and overland flow which leads to increased sedimentation and peak flows. This could reduce riparian condition, aquatic habitat quality and quantity. However, these impacts are only expected to occur until ground cover vegetation recovers and has the ability to dissipate flows and trap sediment, which depends on when precipitation comes. Design features for extent of high burn severity as well as spatial and temporal spacing of activities within a watershed are expected to minimize potential impacts.

Riparian condition for Little Colorado spinedace, desert sucker and Sonoran sucker is currently impaired, therefore indirect effects are expected to be higher. Vegetation in these systems is not adequate to capture or process sediment, indicating more could potentially reach streams. Impaired riparian areas are often disconnected from the water table and are more reflective of upland species and therefore unable to dissipate stream energy associated with increased peak flows. Riparian condition for all the other species is currently functioning at risk, therefore indirect effects are expected to be less. Vegetation in these systems has loss of vigor, growth, or changes in composition, but is present and able to process sediment and dissipate flows in a limited capacity. Riparian condition for the remaining four species in Fossil Creek is good. While indirect effects could occur, these riparian areas are able to process sediment and dissipate flows. Overall acres of treatment for Gila chub, loach minnow critical habitat, spikedace, and Gila topminnow are less than half of the watersheds in which they occur, further reducing potential effects. Additionally, prescribed burning would only occur in the upper watershed within the project area.

For those species with impaired or functioning at risk riparian condition, elevated sedimentation could negatively impact aquatic habitat, species, and water quality; particularly fish eggs and early life history stages that occur on or within substrate as well as the aquatic macroinvertebrate community structure. Habitat is impacted by filling of spawning substrates which can lead to loss of habitat quality and reduced reproductive success. Potential reductions in fish prey base could also indirectly impact gartersnakes. Peak flows can be increased altering channel forming flows leading to bank erosion and loss of habitat complexity. Reduction in riparian vegetation can lead to decreased organic matter input to support aquatic macroinvertebrates and increases stream temperature.

Long term effects of prescribed burning are expected to be positive for riparian condition. Reduced fuel loading would protect these areas from uncharacteristic wildfire in the future. Large woody debris recruitment and streamside cover or structure can also improve with prescribed fire. Fire plays an important role in maintaining heterogeneity in riparian and aquatic systems that has been excluded similar to surrounding uplands (Gresswell 1999); therefore, restoring the fire regime would have some benefits to riparian condition.

Design features related to prescribed fire are expected to minimize the potential effects described above. The project includes spreading treatments in time and space within a watershed (SW054), fireline criteria (FE008, SW050-51, TR002), riparian criteria (SW053), general fire (FE003, FE007) and cumulative impacts (FE011) are expected to reduce potential impacts. The project also includes a design feature to protect herbaceous regrowth post-treatment from livestock grazing if necessary (RM004, SW012).

Table 79. Change by species in the acres of prescribed burning for all alternatives. Percentages reflect changes in acreages within species analysis areas.

Species	Alternative 1: Acres of Prescribed burning	Alternative 2: Acres of Prescribed Burning/ Percentage of Action Area	Alternative 3: Acres of Prescribed Burning/ Percentage of Action Area
Gila trout	0	89,598/ 81%	71,775/ 65%
Gila chub and critical habitat*	0	2,358/ 20%	2,296/ 20%
Gila topminnow*	0	11,681/ 94%	1,331/ 11%
Little Colorado spinedace	0	117,052/ 71%	94,099/ 46%
Little Colorado spinedace Critical Habitat	0	39,410/ 58%	35,848/ 53%
loach minnow critical habitat*	0	11,681/ 94%	1,331/ 11%
spikedace*	0	11,681/ 94%	1,331/ 11%
spikedace critical habitat*	0	27,734/ 92%	3,841/ 13%
narrow-headed gartersnake	0	30,856/ 66%	24,618/ 52%
narrow-headed gartersnake critical habitat	0	43,825/ 94%	30,818/ 66%
Chiricahua leopard frog	0	99,653/ 82%	81,595/ 68%
Chiricahua leopard frog critical habitat	0	8,666/ 99%	8,447/ 96%
desert sucker	0	204,050/ 64%	165,370/ 52%
Sonoran sucker	0	37,572/ 72%	30,606/ 59%
Little Colorado sucker	0	96,943/ 43%	94,882/ 42%
headwater chub	0	113,196/ 76%	95,383/ 64%
roundtail chub	0	144,669/ 90%	97,185/ 60%
northern leopard frog		26,742/ 63%	13,836/ 33%

*While the percentage is high for these species action areas, less than half of entire watershed(s) are within the project area.

Use or Creation of Temporary Roads

Temporary roads can cause negative impacts to riparian condition, habitat connectivity, as well as potentially introduce pollutants and or aquatic invasive species. Under alternative 2, up to 330 miles of temporary roads could be utilized to facilitate mechanical vegetation activities. While for alternative 3, up to 170 miles roads could be utilized. These may be new locations and/or non-system roads and they would be decommissioned when work is completed in the area that the access.

Temporary roads have the potential for short and long-term impacts to aquatic indicators. Design features preclude the creation of new temporary roads in an aquatic management zone, but existing non-system roads can be utilized. Negative short-term impacts would result if they occur within species habitat to riparian condition, habitat connectivity, individuals, and introduction of pollutants or aquatic invasive species. Effects to riparian condition include reduced riparian vegetation cover or structure which are components of frog and gartersnake critical habitat as well as some aquatic macroinvertebrate species habitat (Nokomis fritillary). Reduction in canopy cover could subsequently lead to localized increases stream temperature. The number of stream crossings could also increase which can fragment habitat unless they allow for fish passage and lead to increased sedimentation from streambank damage (lead in/out). Harm could potentially occur to individuals at stream crossings or within riparian areas if a

temporary road was along a stream. Associated ground disturbance and increased sedimentation delivery to riparian areas and streams is expected to occur short-term until the roads were decommissioned. Design features for limiting stream crossings, not creating new temporary roads in aquatic management zones, and reducing impacts of crossings on temporary roads are expected to minimize the potential impacts discussed above.

Negative impacts of opening temporary roads in the species action areas could also occur to riparian condition. In general, roads compact soils and reduce infiltration of water leading to increased erosion and runoff. They increase the drainage network to riparian areas and streams and connect these areas to the uplands by altering surface water pathways. This converts dispersed surface runoff and sediment filtering through a riparian area to direct deliveries of accumulated runoff and sediment. Decreases in riparian condition from increased in peak flows and sedimentation could occur, but would vary based on their current condition.

Pollutants and aquatic invasive species can be introduced directly or indirectly to aquatic systems from machinery or vehicles creating or using temporary roads but are not expected given implementation of project design features. Pollutants in the form of fuels and lubricants have the potential to be introduced into aquatic systems from staging areas and equipment. Spills and leaks can introduce pollutants to soils and then to streams and riparian areas reducing riparian condition and habitat quality. However, there are six design features to prevent contaminants from entering riparian areas, waterbodies and aquatic habitats which minimizes the potential impact. These measures range from checking for leaks daily to refueling and staging areas being outside aquatic management zones (AQ003, SW015-16, SW074). Similarly, aquatic invasive species or diseases can be introduced to aquatic systems from machinery or vehicles creating or using temporary roads. However, design features for decontamination of equipment (AQ001, AQ023, AQ028, AQ038) and not transferring water (AQ026) are expected to reduce potential introduction or spread of invasive species. Implementation of project design features are not expected to introduce or spread any pollutants, disease, or aquatic invasive species.

Long term, potential negative impacts of temporary roads would cease as roads were decommissioned and revegetated. Therefore, long-term effects are considered neutral to aquatic resource indicators. Overall, the potential short-term negative impacts of temporary roads would be more for alternative 2 than alternative 3 and no effects would occur from alternative 1.

Sensitive Species not Covered by Resource Indicators and Measures

Aquatic Macroinvertebrates

Stoneflies, caddisflies, mayflies, midges, and riffle beetles have diverse diets and feeding strategies, occupy different trophic levels and functional feeding groups from predators to filter feeders. Nymphs of the four groups are aquatic while adults stay in the riparian areas for reproduction.

Based on the biology and ecology of these four groups of species, suitable stream and riparian habitat could have negative short term impacts to habitat quality from alternatives 2 and 3. While vegetation management actions in uplands can increase erosion and sedimentation, project design features are expected to minimize that potential. Treatments within aquatic management zones have the potential for short term impacts of sedimentation, reduced riparian vegetation, and altered stream habitats due to nearness to habitat. Alternatives 2 and 3 would have long-term benefits from reducing the risk of uncharacteristic wildfire and associated impacts to aquatic systems.

Nokomis Fritillary is a sensitive species that utilizes wetlands. Alternatives 2 and 3 could have short-term negative and long-term beneficial impacts to the species habitat. Mechanical vegetation treatments and prescribed burning in wetlands can increase erosion and sedimentation, alter riparian vegetation as

described above, but are minimized by design features. More importantly it could reduce the availability of the butterflies host plant (*Viola nephrophylla*) and thus habitat quality short term until plants regrew. Alternatives 2 and 3 would have long-term benefits of reducing conifer encroachment into wetlands providing higher quality habitat and reducing the risk of uncharacteristic wildfire.

California floater was once present in Fossil Creek, West Clear Creek, and Upper Clear Creek and it is possible that it may still occur within Chevelon Creek below Chevelon Dam. Direct and indirect negative impacts could occur in two of the watersheds, while only indirect impacts would occur in Chevelon Creek and Fossil Creek. Mechanical vegetation treatments, prescribed burning, and roads can increase erosion and sedimentation, alter riparian vegetation, and alter stream habitats as described for other aquatic species above. Alternatives 2 and 3 would potentially having long-term benefits from reducing the risk of uncharacteristic wildfire and associated impacts to aquatic systems.

Cumulative Effects

The cumulative effects analysis geographic boundary is the Rim Country project area as this area includes all actions associated with implementation for this analysis. Additionally, for some species and some activities it can include private lands within the forest boundaries and lands adjacent to, or upstream and downstream of the project area. Temporal boundaries went back 30 years in time to include any activity with geospatial data on for quantitative analysis. Past management activities that did not have geospatial data were described by general resource area along with potential last effects going back further in time.

Cumulative effects to aquatic species and habitats are those effects from past, other present, and reasonably foreseeable future projects that result in changes to vegetative cover, soil and stream flow conditions, and contaminants that affect riparian condition and habitat. Activities that could have a cumulative effect include recreation such as dispersed camping and illegal road and trail creation, OHV use, forest restoration projects, fuels reduction projects, wildfire, roads and trails, road closures, and climate change. Most activities would be expected to result in localized impacts short term.

Cumulative Effects for Alternative 1

Under alternative 1, there would be no affect during implementation to species, riparian condition or habitat. However, the ability to retain sustainable and resilient ecosystems would be further compromised by the impacts of climate change, vulnerability to high-severity fires and associated post-fire flooding. Conifer encroachment would continue into riparian areas reducing streamside vegetation cover and structure normally associated with streams and wetlands negatively impacting riparian condition and habitat. Alternative 1 does not provide for improved riparian condition, aquatic species, or habitat. Alternative 1, when added to past, present and reasonably foreseeable future actions, would continue to put aquatic species and their habitats at risk.

Cumulative Effects common to Alternatives 2 and 3

Timber Harvest and Vegetation Management

Past timber harvest activities have resulted in substantial negative impacts to watersheds, hydrologic conditions, riparian and aquatic habitat, and fish species across the proposed project area. This activity has resulted in most of the existing maintenance level 1 and 2 roads. More recent vegetation treatments such as Upper Beaver Creek, Rim Lakes, Larson, and CC Cragin likely have had less impacts due to spreading treatments across watersheds in time and space to reduce overall watershed and soils impacts. Fuelwood collecting and harvesting is also a very widespread activity occurring across the project area, but is generally dispersed across the landscape which limits any potential increased sedimentation or ground disturbance.

Cumulative effects of past timber harvest would combine with short-term increases in sediment delivery and peak flows. These are expected to vary based on current riparian condition. Cumulative impacts for species such as the narrow-headed gartersnake, desert sucker, and Sonoran sucker with overall poor riparian condition are expected to be higher as compared to riparian conditions that are in good or fair condition. Vegetation in poor riparian condition is not adequate to capture sediment, are often disconnected from the water table and are more reflective of upland species. Therefore, they have less ability to process additional sediment or stream flows. As described previously, riparian condition for all the other species is in good to fair riparian condition so they are able to process pulses of sediment and stream flow. To reduce the potential for cumulative impacts of sedimentation and peak flows, design features such as, spreading treatments out in space and time within watersheds are part of all recent and planned forest restoration projects such as CC Cragin, Rim Lakes, and East Clear Creek.

Recreation and Recreation Management

Recreational activities occur throughout the proposed project area, and are continuing to increase. Developed recreation sites, dispersed camping, hiking, fishing, hunting, OHV use, boating, wildlife viewing, and many other types of recreational activities occur across proposed project area. Riparian areas, lakes, and streams are very popular areas for recreational activities and dispersed camping; this can result in localized deteriorated resource conditions from the concentrated use (for example, loss of vegetation and soil compaction), and can also impact water quality from sedimentation. Recreational activities can also facilitate the spread of diseases, aquatic invasive species, and nonnative aquatic species which compete with and predate upon native federally listed and sensitive species.

Recreational activities would be expected to combine with Rim Country in localized impacts short-term decreases in riparian condition, increased sedimentation, and increases in disease and aquatic invasive species. Implementation of travel management should decrease OHV impacts while state and federal educational programs continue to inform the public of how to reduce potential spread of aquatic diseases or invasive species. The Rim Country Project would not have a cumulative effect on presence or spread of nonnative aquatic species.

Fire Suppression and Fire Management Projects

Fire suppression activities have been in place for decades, and have resulted in unnatural vegetative conditions and have altered ecological processes across most of the proposed project area. Suppression activities are ongoing and would continue well into the future, as vegetation structure and composition has been altered so that allowing it to burn would result in uncharacteristic and unacceptable resource impacts. Fire suppression activities can also impact water resources and species dependent upon them by removing water, which usually occurs during the driest part of the year. Prescribed fire and burns have been occurring for the last 10 to 20 years, and have increased considerably in their extent and impacts over the last 5 to 10 years. Large, uncharacteristic wildfires have occurred across the proposed project area in the last 20 to 25 years, such as Rodeo-Chediski Fire (2002).

Past fire management has resulted in the current condition in many watersheds from years of fire suppression leading to the uncharacteristic fires occurring recently. Wildfires can have both impacts that are both positive and negative as described previously and depend upon burn severities. Cumulatively these impacts would be dependent on the existing resource conditions and the future environmental conditions. Climate change is expected to result in increased temperature, frequency and intensity of drought, and wildfire risk; which could result in increased sedimentation and reduced riparian condition across large portions of the project area. The proposed action would limit this effect by making forest conditions more resilient to large-scale wildfire.

Livestock Grazing

Grazing livestock has likely occurred for over a century across the proposed project area. Historically unrestricted and unregulated resulted in overgrazing, especially within riparian areas, has likely contributed to the degraded riparian and aquatic habitat conditions that currently occur. Livestock grazing occurs over most of the proposed project area, although some areas are excluded for resource recovery reasons. Infrastructure development and maintenance associated with livestock grazing allotments is substantial and can include brushing or removal of vegetation as well as stock tank cleaning. Instream stock tanks occur throughout the proposed project area which decrease stream flow and alter stream habitat, particularly if tanks cause channel incision. Impacts to aquatic habitat and species, hydrologic conditions and processes, and riparian and upland conditions have occurred; and this would continue as long as livestock management and the associated infrastructure remains in place and contributes cumulative effects to aquatic species and their habitats.

Cumulative effects of livestock grazing would combine with short-term impacts to riparian condition through loss of understory vegetation and increased sedimentation. Allotments in and around the project area should be managed on a grazing system designed to allow forage a chance to recovery from livestock grazing reducing the potential for cumulative impacts. Pastures may be rested or deferred after completion of ground disturbing activities (for example, thinning or burning) to minimize impacts to vegetation. This when combined with the effects of other past, present, and foreseeable future activities in area is not expected to result in a net cumulative effect of disturbance to aquatic species or habitats.

Road and Trail Construction, Maintenance, and Closure

As previously stated, past timber activities and harvest primarily accounted for road development and placement, and this is still reflected in the existing transportation system. Approximately 5,127 miles of roads and almost as many miles of hiking trails occur within the Rim Country project area. User created roads and trails also occur on the landscape and further increase the overall mileage. While roads and trails are necessary for the use, enjoyment, and management, they also are responsible for considerable landscape scale changes to the functioning and maintaining of ecological processes and values. Maintenance activities for roads and trails are limited by available funding, and can result in both positive and negative benefits, depending on when it occurs and how often. These impacts would continue as long as the roads/trails are in place, and are a major contributor to cumulative effects. The Coconino National Forest has closed over 90 miles of roads as part of focused watershed restoration activities in the Little Colorado River watershed. Continued use and maintenance of roads and trails can increase sedimentation to streams and cause fish passage barriers.

Cumulative effects of roads and trails would combine with short to long-term increases in sediment delivery and peak flows from the Rim Country Project. These are expected to vary based on current riparian condition as previously described under timber harvest. Conversely, improvement in habitats would be expected in those areas where road densities are reduced, and habitat connectivity increased under implementation of travel management regulations and restoration activities that improve forest resiliency and riparian condition and stream habitat. All temporary roads for the project would be decommissioned, further reducing cumulative effects long-term.

Special Uses and Permits/Minerals Management/Land Exchanges

Hundreds of special uses permits have been issued across the proposed project area. These include permits for outfitter and guiding activities, fuelwood and Christmas tree cutting, road easements, plant and minerals collection, church and youth camps, gravel and cinder pits, ditch bill easements, communications sites, and other uses as well. All of these activities have contributed to current conditions, particularly ditch bill easements which can reduce the available water for aquatic habitat.

Cumulative effects of special uses, minerals, and land exchanges would combine with short term, localized increases in sedimentation and spread of aquatic invasive species or disease. The action alternatives limit these effects by keeping rock pits far away from aquatic habitats and reclaiming these areas when no longer needed. Design features associated with the action alternatives are expected to minimize or remove the potential for introduction or spread of aquatic invasive species or disease.

Dam and Reservoir Development/Water Diversions

These projects have resulted in considerable impacts to aquatic habitat and species both directly and indirectly. Dam and reservoir development began in the late 1800s and continued into the 1960s across the project area, altering stream habitat into lake habitat. Most of this activity was to provide for downstream (and off Forests) water use and irrigation as well as to provide for recreational opportunities. Blue Ridge Reservoir is part of an interbasin transfer to the Verde River from the Little Colorado River drainage to provide water downstream. Most dams and water diversions have detrimental impacts to aquatic species and habitats such as isolated or separated populations, loss of available habitat, and dewatered streams.

Cumulatively, these actions are part of the existing stream conditions. The action alternatives would improve remaining stream habitat and associated riparian areas. While there would be short-term increases in sedimentation from stream or riparian restoration; riparian and stream conditions would be improved long-term.

Fisheries and Wildlife

Fisheries habitat improvement work in streams began in the 1930s on the Apache-Sitgreaves National Forests. These efforts were in response to degraded habitat conditions (likely from grazing livestock) and were focused on higher elevation trout streams, and intended to stabilize streams and provide pool habitat that had been reduced. Later efforts did not occur until the 1970s thru the 1980s, and these efforts were largely focused on areas that had been heavily impacted by past management activities and concentrated recreational use. The Coconino National Forest began improving streams, springs and watersheds in the 1960s through the 1990s in response to the degraded conditions. This included instream rock structures and aspen and riparian enclosures. Spring and stream restoration efforts began in the early 2000s as part of watershed planning for West and East Clear Creek as well as Barbershop Canyon.

Cumulatively, aquatic restoration activities have been individual, small efforts with localized, short-lived impacts of increased sedimentation and long-term habitat improvement where they have occurred. The action alternatives would improve riparian condition and aquatic habitats across the landscape.

In summary, long term cumulative effects are expected to be positive for riparian condition for alternatives 2 and 3. Alternative 2 has the greatest potential to improve overall riparian condition as well as watershed condition due to highest acreage being treated. Alternative 3 would maintain or improve conditions, but at a smaller scale due to less acreage restored. Risk associated with dense forest conditions would be reduced and forest resiliency to large scale disturbance under drier and warmer conditions would be improved by implementing the proposed treatments under all action alternatives.

Determination of Effects

Gila trout

Short-term adverse effects could result to recovery and recreational populations of Gila trout within the project area from mechanical thinning and burning. Project design features are expected to minimize potential adverse effects of thinning and burning, particularly spreading out treatments spatially and temporally to reduce overall impact and allow reestablishment of ground cover. Additional design features

for thinning and burning in aquatic management zones further reduce potential ground disturbance such as equipment driving in and backing out and no dug handlines in aquatic management zones. Because of implementation of project design criteria, no meaningfully measurable effects are expected. Long-term benefits of thinning and burning include reduced risk of uncharacteristic fire and improved watershed condition.

Opening 2 miles of ML-1 roads and an associated 7 low water crossings in Gila trout habitat could have short-term adverse effects under alternatives 2 and 3. These increases occur in Ellison (six crossings) and Workman Creeks (one crossing). Additionally, a total of 161 miles of ML-1 roads and 213 low water crossings could be used within the species action area. Road crossings actively produce sedimentation through vehicular disturbance or road maintenance activities and passively through erosion of the disturbed banks forming the sides of crossings. Subwatersheds that contain Ellison and Workman Creeks have riparian condition that is currently functioning at risk (fair) and show as impaired for the roads and trails indicator. This can mean either high open road density, maintenance costs, and/or proximity to water in the baseline. Increased sedimentation to trout streams can reduce water quality, reduce spawning gravel quality, fill in pools, and reduce food resources. This can result in decreased reproductive success or survival of particularly younger age classes. Roads and crossings within species habitats would have increased effects, but the incremental increases of sediment from roads and crossings would be additive. While not all ML-1 roads or crossings would be utilized at the same time, they have the potential for short-term adverse effects from increased sedimentation.

Stream restoration could have adverse and beneficial effects to Gila trout under alternatives 2 and 3. Restoration occurs in 8 of 32 miles of Gila trout streams; of those only four miles could utilize heavy mechanical stream restoration methods. Design features for block netting instream work areas and timing restrictions determined by listed species present (during spawning seasons) reduce the potential for harm individuals or redds. Short-term inputs of sediment could result from mechanical stream restoration that occurs inside or near the bankfull channel. The sediment plume from activities will be most concentrated in the immediate project area and should dissipate within a few hours. The increased stream turbidity may deposit fine sediment on substrate a short distance downstream, encourage fish to move downstream, and alter behavior patterns for a short time. It is anticipated that all project related sediment will be flushed out during the first high flows after project completion. Project design features are expected to prevent sediment inputs from persisting into the future, therefore, long-term negative impacts from sediment are not expected. Stream restoration activities will provide immediate and long-term benefits to Gila trout habitat such as decreased direct sediment inputs from unstable banks or headcuts, increased habitat complexity and thermal refugia, and improved riparian areas and stream shading.

Potential long-term benefits in Gila trout habitat from improved watershed, riparian, and stream habitat would contribute to species recovery while reducing potential impacts from uncharacteristic fire. While negative effects are mitigated for most activities, short term effects from ML-1 roads, low water crossings and stream restoration to Gila trout are not at a level where they can be considered insignificant or discountable. Therefore, the determination for Gila trout is “May Affect, Is Likely to Adversely Affect” for alternatives 2 and 3.

Gila Chub and Critical Habitat

While project mechanical thinning and prescribed burning is proposed in the action area, effects are not expected. Occupied and designated critical habitat occurs 10 miles downstream of the project area, which occurs in the upper portions of the watershed. Less than 10 percent of the upper Red Tank Draw subwatershed would be mechanically thinned or burned over time. Project design features are expected to minimize potential adverse effects of thinning and burning, particularly spreading out treatments spatially

and temporally to reduce overall impact and allow reestablishment of ground cover. Given less than 10 percent of the subwatershed could be treated, no adverse effects or benefits of reduced fire risk or improved watershed condition are expected. Because of implementation of project design criteria, no effects are expected from mechanical thinning or prescribed burning.

Up to 5 miles of ML-1 roads and one associated stream crossing would occur within the action area. Given the distance to occupied habitat and no perennial streams associated with these actions, no effects are expected from roads.

Due to location of project activities from occupied or critical habitat, small percentage of action area treated, and associated design features no potential adverse or beneficial effects are expected to occur. Therefore, no effects are expected to occur to Gila chub or its designated critical habitat.

Gila Topminnow

While project activities could occur in the upper Fossil Creek watershed, no negative effects are expected. Species habitat occurs over seven miles downstream of the project area. While mechanical thinning and burning would occur in the Upper Fossil Creek subwatershed over time, design features are expected to minimize any potential negative impacts of sedimentation, particularly spreading out treatments spatially and temporally to reduce overall impact and allow reestablishment of ground cover. Given almost 43 percent of the Upper Fossil Creek subwatershed would be treated, long-term benefits of improved watershed condition and reduced fire risk may lead to improved watershed function for the species in Lower Fossil Creek. Therefore, the determination for Gila topminnow is “May Affect, Is Not Likely to Adversely Affect” due to the expected beneficial effects.

Little Colorado Spinedace and Critical Habitat

Implementation of the proposed action has the potential to benefit habitat for Little Colorado spinedace by improving stream and riparian conditions and especially by improving conditions in wet meadows. Improvement will help improve water retention in the upland meadows may help maintain water in downstream areas in dry times. In addition, risk of uncharacteristic wildfire in watersheds containing Little Colorado spinedace should be decreased by upland vegetation treatments.

There is the potential some short-term adverse impacts within the project area associated with project implementation. Ground disturbing activities associated with mechanical thinning, prescribed burning, opening of ML-1 roads and stream restoration can impact spinedace by altering water quality and increasing sedimentation into streams, resulting in altered habitat conditions and reduced food resources. Design features associated with the project should minimize potential negative impacts, particularly spreading out treatments spatially and temporally to reduce overall impact and allow reestablishment of ground cover. Within species habitat mechanical thinning, prescribed burning and one mile of ML-1 road with an associated low water crossing may be opened across an intermittent tributary to Leonard Canyon. Impacts of channel widening and sedimentation would exist while the road and crossing were open but would be reduced once closed. Even with multiple design criteria to mitigate sedimentation, given close proximity to occupied habitat short term impacts of sedimentation from ground disturbing activities could occur.

There are 113 miles of spinedace habitat within the project area that may be identified for stream restoration. Of those, only eleven miles are heavy mechanical treatments. While heavy mechanical stream restoration has adverse impacts from sedimentation during implementation, the benefits to the species are realized much faster. The impacts of stream restoration generally dissipate faster than vegetation management impacts and benefits can be almost immediate. The potential for harm or harass individuals

during instream restoration work is minimized by design features to coordinate and collaborate with USFWS and AZGFD and isolating instream work areas. Within spinedace watersheds and additional 118,974 acres of mechanical thinning and 144,124 acres of burning could occur. In addition, up to 514 miles of ML-1 roads may be utilized with an associated 191 low water crossings during the life of the project. Spreading treatments out in time and space within a watershed and limits on percent of a watershed treated provide for soil condition and herbaceous recovery, but the potential for increased sediment exists particularly given current poor riparian condition. Potential long-term benefits to spinedace habitat from improved watershed, riparian, and stream habitat could contribute to species recovery while reducing potential impacts from uncharacteristic fire. While impacts would be mitigated, short term impacts to spinedace are not at a level where they can be considered insignificant or discountable. Therefore, the determination for spinedace and its designated critical habitat is “May Affect, Is Likely to Adversely Affect.”

Effects to spinedace designated critical habitat. Proposed activities within critical habitat include 102 and 114 acres of mechanical thinning and prescribed burning and 31 miles of stream restoration with 2 miles of potential heavy mechanical stream work. Within critical habitat watersheds an additional acre of mechanical thinning, prescribed burning and 7 acres of in woods processing could occur. Design features are expected to minimize effects from these actions. Up to 82 miles of ML-1 roads could be utilized and an associated 87 low water crossings within critical habitat watersheds throughout the life of the project. Short term adverse effects could occur to spinedace critical habitat PCEs 1a, 1d-e, 2b-c from increased sedimentation or ash, decreased vegetative cover, and disease. Project activities would not impact PCEs 1b-c, 2a relating to instream vegetation, nonnatives, presence of water. Potential long-term benefits of improved watershed and stream function should improve value and contribute to recovery. For the reasons stated above and in table 80 the determination is for spinedace designated critical habitat is “May Affect, Is Likely to Adversely Affect.”

Loach Minnow and Critical Habitat

While project activities could occur in the upper Fossil Creek watershed, no beneficial or negative effects are expected to loach minnow. Stockings of loach minnow into Fossil creek were not successful in establishing the species and it is not considered as present. Therefore, the determination for loach minnow is “No Effect”.

Effects to designated critical habitat may occur similar to discussions above. The project is not expected to result in adverse effects to loach minnow critical habitat (PCEs 4 & 6) because critical habitat does not occur within with project area. Negative effects to PCEs 1, 2, and 3 from sedimentation or ash in upper portions of the watershed or pollutants are not expected due to stream distance from the project area and implementation of project design features. Project activities would not impact PCE 5 relating to level nonnative species. All the PCEs except 4 & 5 may have long term benefits from projected improvement of watershed function and reduced fire risk. For the reasons stated above is “May Affect, Is Not Likely to Adversely Affect” for loach minnow critical habitat due to the potential for long-term beneficial effects.

Spikedace and Critical Habitat

The only current population of spikedace in the project area is the recently been reintroduced into Fossil Creek. Initial surveys indicate recruitment and indicate a successful reestablishment of this species over ten miles downstream from the project boundary.

While project activities could occur in the Upper Fossil Creek watershed, no negative effects are expected. Species habitat occurs over 7 miles downstream of the project area. Mechanical thinning and prescribed burning could occur within the species area. Project design features are expected to minimize

any potential negative impacts of sedimentation, particularly spreading out treatments spatially and temporally to reduce overall impact and allow reestablishment of ground cover. Given almost 43 percent of the Upper Fossil Creek subwatershed would be treated, long-term benefits of improved watershed condition and reduced fire risk may lead to improved watershed function for spikedace in Lower Fossil Creek. Therefore, the determination for spikedace is “May Affect, Is Not Likely to Adversely Affect” due to the expected beneficial effects.

Effects to designated critical habitat may occur similar to other fish species. The project is not expected to result in adverse effects to spikedace critical habitat (PCEs 4 and 6) because critical habitat does not occur within with project area. Negative effects to PCEs 1, 2, and 3 from sedimentation or ash in upper portions of the watershed or pollutants are not expected due to stream distance from the project area and implementation of project design features. Project activities would not impact PCE 5 relating to level nonnative species. All the PCEs except 4 and 5 may have long-term benefits from projected improvement of watershed function and reduced fire risk. For the reasons stated above the determination is “May Affect, Is Not Likely to Adversely Affect” for spikedace critical habitat due to the potential for long-term beneficial effects for alternatives 2 and 3.

Narrow-headed Gartersnake and Critical Habitat

While implementation of alternative 2 has the potential for long term beneficial impacts, short term adverse effects could result to narrow-headed gartersnakes and proposed critical habitat. Overall, there is less than 552 acres of proposed mechanical thinning and burning within narrow-headed gartersnake habitat, 288 acres in Canyon Creek and 262 acres in Haigler Creek. In addition, 31,602 acres of mechanical thinning and 43,825 acres of prescribed burning may occur outside species habitat, but within the action area. Vegetation management within species habitat would reduce herbaceous cover short term. Design features associated with the project should help reduce and minimize any potential negative impacts, particularly spreading out treatments spatially and temporally to reduce overall impact and allow reestablishment of ground cover. Design features for thinning and burning in aquatic management zones (FE006) further minimize reductions in ground cover such as equipment driving in and backing out and limitation on fireline aquatic management zones. Firelines would only be constructed in aquatic management zones with approval and can only consist of non-ground disturbing techniques (SW008). Brushing (cutting woody shrubs) is one method that may be used which would reduce hiding cover for gartersnakes. Additional design criteria specific to gartersnakes reduce potential harm from vegetation management. AQ019 outlines a 150 feet aquatic management zone for gartersnakes and does not allow for piling of any kind to occur within in them. Gartersnakes would utilize piles as hiding cover, which could lead to harm during prescribed burns. The design feature further reduces potential harm during the snake’s hibernation period by minimizing disturbance of rock/boulder piles and woody debris within the aquatic management zone. Long-term benefits of thinning and burning include reduce risk of uncharacteristic fire and improved watershed condition.

Up to one mile of ML-1 roads could be utilized and an associated five low water crossings added in Canyon Creek within gartersnake habitat throughout the life of the project. Less than 0.03 mile of ML-1 road and no low water crossings would occur in Haigler Creek. Localized impacts of channel widening, and sedimentation would exist while the roads were open but would be reduced once closed. Road crossings actively produce sedimentation through vehicular disturbance or road maintenance activities and passively through erosion of the disturbed banks. Design features for low water crossings would reduce potential sedimentation during that time period but not eliminate it which could lead to behavioral changes (avoidance) at the crossing within gartersnake habitat. To facilitate thinning treatments, an additional 114 miles of ML-1 roads may be opened in the Canyon Creek subwatershed and 30 miles in the Haigler Creek subwatershed with 30 and 39 low water crossings, respectively. While riparian

condition in gartersnake action area is functioning at risk (fair), the specific roads trails indicator is functioning at risk for the Canyon Creek subwatershed and impaired for Haigler Creek. This can mean either high open road density, maintenance costs, and/or proximity to water in the baseline. Design features and roads best management practices are expected to reduce sedimentation, but some of the ML-1 roads are along intermittent drainage bottoms such as Lost Salt Canyon which have a higher potential for increased sedimentation to Haigler Creek. Similarly, multiple low water crossings occur on perennial tributaries to Canyon Creek. The incremental increases to the roads and crossings baseline would indicate the potential for measurable increased sedimentation during use and short-term negative effects. Increased sedimentation leads to turbidity and embeddedness which can reduce prey base and hunting ability for narrow-headed gartersnakes.

Short term adverse effects and long-term benefits to gartersnakes are expected from stream restoration activities. General stream restoration can occur in only 7 miles of gartersnake habitat within Canyon and Haigler Creeks, with the potential for three miles of heavy mechanical treatments in Canyon Creek which have the potential to displace or harm individuals. General stream restoration techniques are geared toward riparian restoration (planting, fencing, etc.) which has the potential to disturb individuals but is not overly ground disturbing or leads to removal of vegetation used for hiding cover, brumation, or thermoregulation. Construction activities associated with heavy mechanical methods would also disturb individuals and could result in a flight response, possibly resulting in harassment, injury, or death. Similar effects could also occur from heavy machinery working next to the stream bank, working in the stream, or during excavation activities. Stream restoration implemented during the surface-active period provides an opportunity for gartersnakes to escape the adverse effects of machinery. Design feature AQ020 provides for biologist to be involved in pre-planning of all treatments in aquatic systems while AQ023 requires early interagency coordination to identify survey needs and disposition of gartersnakes impacted during implementation which are expected to minimize potential harm. Heavy mechanical stream restoration has adverse impacts from sedimentation during implementation, those impacts dissipate after the first high flow event and benefits are almost immediate. Potential long-term benefits in gartersnake habitat from improved watershed, riparian and stream habitat could contribute to species recovery while reducing potential impacts from uncharacteristic fire. Although impacts would be mitigated, impacts to narrow-headed gartersnake are not at a level where they can be considered insignificant or discountable. Therefore, the determination for narrow-headed gartersnake is “May Affect, Is Likely to Adversely Affect.”

The greatest threat to narrow-headed gartersnake populations is lack of water during drought conditions and predation, competition, and effects on the native fish prey base from nonnative fish, bullfrogs, and crayfish. The project may help improve watershed conditions and the ability of streams to maintain water during drought conditions.

Short term negative effects and long-term benefits to narrow-headed gartersnake proposed critical habitat in Canyon Creek and Haigler Creek may occur. Mechanical thinning and prescribed burning are proposed within and outside of critical habitat in Canyon Creek and Haigler Creek. Up to 7 miles of general stream restoration along both critical habitat units is proposed and 3 miles of potential heavy mechanical stream work in Canyon Creek. In addition, up to 56 miles of ML-1 roads could be utilized and an associated 74 low water crossings within critical habitat watersheds throughout the life of the project. The project is not expected to result in adverse effects to narrow-headed gartersnake critical habitat (PCEs 2a, 2b, & 4) associated with flows, hydrologic connections, and nonnatives. Short-term adverse effects could occur to PCEs 1a-d, 2c-d, & 3 from increased sedimentation or ash, decreased vegetative cover, and reduced prey base. Project activities would not impact PCE 5 relating to elevation. While short-term impacts to PCEs may occur, none should appreciably diminish the value for survival and recovery of the species long term.

Potential long-term benefits of improved watershed and stream function should improve value and contribute to recovery. For the reasons stated above the determination is for narrow-headed gartersnake proposed critical habitat is “Not Likely to Adversely Modify”. Should critical habitat be designated in the future, the determination would be “May Affect, Is Likely to Adversely Affect.”

Chiricahua leopard frog

While implementation of alternative 2 or 3 has the potential for long-term beneficial impacts, short-term adverse effects could result to Chiricahua leopard frog. Mechanical thinning and prescribed burning are proposed within frog dispersal habitat and outside of dispersal habitat but within the species action area. Project design features are expected to minimize potential adverse effects of vegetation management from increased sedimentation which can alter water quality and reduced herbaceous or woody cover, particularly spreading out treatments spatially and temporally to reduce overall impact and allow reestablishment of ground cover. Additional design features for thinning and burning in aquatic management zones further reduce potential decreases in ground cover such as equipment driving in and backing out and no dug handlines in aquatic management zones. Design criteria specific to leopard frogs also reduce the potential for harm or harassment in the form of displacement, injury, or death from vegetation management activities. The 150-foot aquatic management zone is for frogs and does not allow for skid trails without biologist approval. Mechanical thinning in frog habitat would not occur in aquatic management zones within three days of a rain event to reduce potential harassment or harm when frogs are most likely to disperse. These mitigations reduce the potential for harm to individual frogs within dispersal habitat. Long-term benefits of thinning and burning include reduce risk of uncharacteristic fire and improved watershed condition.

Opening of ML-1 roads and associated low water crossings pose the highest risk and potential effects to frogs and their habitat. Up to 26 miles of ML-1 roads could be utilized and an associated 186 low water crossings added within frog habitat throughout the life of the project. An additional 211 miles of ML-1 roads and 186 low water crossings could be opened outside of frog habitat, but within the action area. Roads and crossings actively produce sedimentation through vehicular disturbance or road maintenance activities and passively through erosion of the disturbed banks forming the sides of crossings. Action area subwatersheds have riparian condition that is currently fair or poor and all have poor ratings for the specific roads and trails indicator. This can mean either high open road density, maintenance costs, and/or proximity to water in the baseline. Design features and roads best management practices are expected to reduce sedimentation, but some of the ML-1 roads are along perennial or intermittent drainage bottoms in multiple areas have a higher potential for increased sedimentation, and reduced cover. Similarly, multiple low water crossings could occur on the same stream creating additive impacts. Use of ML-1 roads and crossings can impact frogs short-term by altering water quality, increasing sedimentation into streams, and reducing herbaceous or woody cover. These lead to altered riparian and terrestrial habitat conditions, reduced algal and macroinvertebrate food resources for tadpoles, reduced foraging and basking habitat, and reduced survival. Design features for low water crossings would mitigate potential sedimentation during that time they were in use but could lead to behavioral changes (avoidance) or possible harm or harassments to dispersing frogs in the form of displacement, injury, or death. While not all ML-1 roads or crossings would be utilized at the same time, those within the same area (timber sale or burn unit) would be. The incremental increases to the roads and crossings baseline would indicate the potential for measurable increased sedimentation during use and short-term negative effects to Chiricahua leopard frog.

Short term adverse effects and long-term benefits to Chiricahua leopard frog are expected from stream restoration activities. Stream restoration is proposed in 19 miles of frog dispersal habitat with the potential for fourteen miles are heavy mechanical treatments which have the potential to displace or harm

individuals. General stream restoration techniques are geared toward riparian restoration (planting, fencing, etc.) which has the potential to disturb individuals but is not overly ground disturbing nor leads to removal of vegetation used for hiding cover or thermoregulation. Construction activities associated with heavy mechanical methods would also disturb individuals and could result in a flight response, possibly resulting in harassment, injury, or death. Similar effects could also occur from heavy machinery working next to the stream bank, working in the stream, or during excavation activities. Stream restoration implemented during the activity period provides an opportunity for frogs to escape machinery. Design feature AQ018 provides for biologist to be involved in pre-planning of all treatments in aquatic systems while AQ020 requires early interagency coordination to identify survey needs and disposition of frogs or gartersnakes found during implementation which are expected to minimize potential harm, but it exists. Heavy mechanical stream restoration can cause plumes of sediment causing increased turbidity and embeddedness during implementation, those impacts are short lived and dissipate after the first high flow event. Beneficial effects on improved instream habitat and habitat complexity are almost immediate. Potential long-term benefits in frogs from improved watershed, riparian and stream habitat could contribute to species recovery while reducing potential impacts from uncharacteristic fire. Although impacts would be mitigated, impacts to Chiricahua leopard frog are not at a level where they can be considered insignificant or discountable.

Potential long-term benefits in frog habitat from improved watershed, riparian and stream habitat could contribute to species recovery while reducing potential impacts from uncharacteristic fire and directly improving habitat. Although impacts would be mitigated, impacts to Chiricahua leopard frog are not at a level where they can be considered insignificant or discountable. Therefore, the determination for Chiricahua leopard frog is “May Affect, Is Likely to Adversely Affect” for alternatives 2 and 3.

Effects to designated critical habitat may occur in either a positive or negative manner. Proposed activities within critical habitat units include 1.6 acres of mechanical thinning and prescribed burning in the Crouch, Gentry, Cherry Creeks, and Parallel Canyon unit and 0.4 acre in the Ellison and Lewis Creeks unit for alternatives 2 and 3. No other activities are proposed within Chiricahua leopard frog critical habitat. Within critical habitat action area mechanical thinning, prescribed burning, 20 acres of in woods processing, and 63 acres of rock pits could occur. In addition, up to 13 miles of ML-1 roads could be utilized and an associated 17 low water crossings within critical habitat action area throughout the life of the project. Short term adverse effects could occur to Chiricahua leopard frog critical habitat PCEs 1a, 1d-e, 2b-c from increased sedimentation or ash, decreased vegetative cover, and disease. Project activities would not impact PCEs 1b-c, 2a relating to instream vegetation, nonnatives, presence of water. Potential long-term benefits of improved watershed and stream function should improve value and contribute to recovery. For the reasons stated above the determination is for Chiricahua leopard frog designated critical habitat is “May Affect, Is Likely to Adversely Affect”.

Desert Sucker, Sonoran sucker, Little Colorado sucker, headwater chub and roundtail chub

Short term adverse effects could result to sensitive fish species or their habitat within the project area from mechanical thinning and burning. Project design features are expected to minimize potential adverse effects of thinning and burning, particularly spreading out treatments spatially and temporally to reduce overall impact and allow reestablishment of ground cover. Additional design features for thinning and burning in aquatic management zones further reduce potential ground disturbance such as equipment driving in and backing out and no dug handlines in aquatic management zones. Because of implementation of project design criteria, no meaningfully measurable effects are expected. Long term benefits of thinning and burning include reduce risk of uncharacteristic fire and improved watershed condition.

Opening ML-1 roads and associated low water crossings within species habitats could have short term adverse effects under alternatives 2 and 3. Additional ML-1 roads and low water crossings could be used within the species action areas. Road crossings actively produce sedimentation through vehicular disturbance or road maintenance activities and passively through erosion of the disturbed banks forming the sides of crossings. Increased sedimentation to streams can reduce water quality, reduce spawning gravel quality and reduce food resources. This can result in decreased reproductive success or survival of particularly younger age classes. Roads and crossings within species habitats would have increased effects, but the incremental increases of sediment from roads and crossings would be additive. While not all ML-1 roads or crossings would be utilized at the same time, they have the potential for short term adverse effects from increased sedimentation.

Stream restoration could have short term adverse and beneficial effects to sensitive fish under alternatives 2 and 3. General stream restoration methods are expected to have only beneficial effects due to lack of ground or vegetation disturbance. Long term benefits of these actions would also occur from plantings and fencing. Heavy mechanical stream restoration would have adverse effects during implementation to species and habitat. Design features for block netting instream work areas and timing restrictions determined by species present (during spawning seasons) reduce the potential for harm individuals or nests. Short-term inputs of sediment could result from mechanical stream restoration that occurs inside or near the bankfull channel. The sediment plume from activities will be most concentrated in the immediate project area and should dissipate within a few hours. The increased stream turbidity may deposit fine sediment on substrate a short distance downstream, encourage fish to move downstream, and alter behavior patterns for a short time. It is anticipated that all project related sediment will be flushed out during the first high flows after project completion. Project design features are expected to prevent sediment inputs from persisting into the future, therefore, long-term negative impacts from sediment are not expected. Stream restoration activities will provide immediate and long-term benefits to sensitive fish habitat such as decreased direct sediment inputs from unstable banks or headcuts, increased habitat complexity and thermal refugia, and improved riparian areas and stream shading.

Potential long-term benefits from improved watershed, riparian and stream habitat would contribute to species viability and stability while reducing potential impacts from uncharacteristic fire. While negative effects are mitigated for most activities, short term effects from ML-1 roads, low water crossings and stream restoration would have short term effects to individuals and habitat, but long-term benefits in improved habitat quality. Therefore, the determination for desert sucker, Sonoran sucker, Little Colorado sucker, headwater chub, and roundtail chub is, may impact individuals or habitat, but would not likely contribute toward federal listing or loss of viability to the population or species for alternatives 2 and 3.

Northern leopard frog

Similar to the discussion above for Chiricahua leopard frog, alternatives 2 or 3 would have long term benefits and short-term adverse effects to northern leopard frog. Mechanical thinning and prescribed burning are proposed within frog dispersal habitat and within the species action area. Project design features are expected to minimize potential adverse effects of vegetation management from increased sedimentation and reduce hiding cover, particularly spreading out treatments spatially and temporally to reduce overall impact and allow reestablishment of ground cover. Design criteria specific to leopard frogs also reduce the potential for harm or harassment in the form of displacement, injury, or death from vegetation management activities. Mechanical thinning in frog habitat would not occur in aquatic management zones within 3 days of a rain event to reduce potential harassment or harm when frogs are most likely to disperse. These mitigations reduce the potential for harm to individual frogs when they are most likely to disperse. Long term benefits of vegetation management include reduce risk of uncharacteristic fire and improved watershed condition.

Opening of ML-1 roads and associated low water crossings pose the highest potential for negative effects to northern leopard frogs and their habitat. Up to 14 miles of ML-1 roads could be utilized and an associated 28 low water crossings added within northern leopard frog habitat throughout the life of the project. An additional 122 miles of ML-1 roads be opened outside of frog habitat, but within the action area. Roads and crossings actively produce sedimentation through vehicular disturbance or road maintenance activities and passively through erosion of the disturbed banks forming the sides of crossings. Action area subwatersheds have an average riparian condition of fair and all have poor ratings for the specific roads and trails indicator. This can mean either high open road density, maintenance costs, and/or proximity to water in the baseline. Design features and roads best management practices are expected to reduce sedimentation, but some of the ML-1 roads are along perennial or intermittent drainage bottoms in multiple areas have a higher potential for increased sedimentation, and reduced cover. Similarly, multiple low water crossings could occur on the same stream creating additive impacts. Use of ML-1 roads and crossings can impact frogs short-term by altering water quality, increasing sedimentation into streams, and reducing herbaceous or woody cover. These lead to altered riparian and terrestrial habitat conditions, reduced algal and macroinvertebrate food resources for tadpoles, reduced foraging and basking habitat, and reduced survival. Design features for low water crossings would mitigate potential sedimentation during that time they were in use but could lead to behavioral changes (avoidance) or possible harm or harassments to dispersing frogs in the form of displacement, injury, or death. While not all ML-1 roads or crossings would be utilized at the same time, those within the same area (timber sale or burn unit) would be. The incremental increases to the roads and crossings baseline would indicate the potential for measurable increased sedimentation during use and short-term negative effects to northern leopard frog.

Short term adverse effects and long-term benefits to northern leopard frog are expected from stream restoration activities. Stream restoration is proposed in 23 miles of frog dispersal habitat with the potential for three miles are heavy mechanical treatments which have the potential to displace or harm individuals. General stream restoration activities have the potential to disturb individuals but is not overly ground disturbing nor leads to removal of vegetation used for hiding cover or thermoregulation. Construction activities associated with heavy mechanical methods would also disturb individuals and could result in a flight response, possibly resulting in harassment, injury, or death. Similar effects could also occur from heavy machinery working next to the stream bank or in the stream. Stream restoration implemented during the frog activity period provides an opportunity for frogs to escape machinery. Design features provide for biologist to be involved in pre-planning of all treatments in aquatic systems and requires early interagency coordination to identify survey needs and disposition of frogs or found during implementation which are expected to minimize potential harm, but it exists. Heavy mechanical stream restoration can cause plumes of sediment causing increased turbidity and embeddedness during implementation, those impacts are short lived and dissipate after the first high flow event. Beneficial effects on improved instream habitat and habitat complexity are almost immediate. Potential long-term benefits in frogs from improved watershed, riparian and stream habitat could contribute to species viability while reducing potential impacts from uncharacteristic fire.

Potential long-term benefits in frog habitat from improved watershed, riparian and stream habitat could contribute to species viability while reducing potential impacts from uncharacteristic fire and directly improving habitat. Therefore, the determination for northern leopard frog is, may impact individuals or habitat but would not likely contribute toward federal listing or loss of viability to the population or species for alternatives 2 and 3.

Aquatic macroinvertebrates

Short term adverse effects could result to sensitive aquatic macroinvertebrates or their habitats could occur from alternatives 2 and 3. Project design features are expected to minimize potential adverse effects of vegetation management activities, particularly spreading out treatments in space and time to reduce overall impact and allow reestablishment of ground cover. Additional design features in aquatic management zones further reduce potential ground disturbance and loss of riparian or wetland vegetation. Because of implementation of project design criteria, no meaningfully measurable effects are expected. Long term benefits of thinning and burning include reduce risk of uncharacteristic fire and improved watershed condition.

Opening ML-1 roads and associated low water crossings within species habitats could have short term adverse effects under alternatives 2 and 3. Road crossings actively produce sedimentation through vehicular disturbance or road maintenance activities and passively through erosion of the disturbed banks forming the sides of crossings. Increased sedimentation to streams can reduce water quality and reduced habitat quality while roads and crossings were being used. While not all ML-1 roads or crossings would be utilized at the same time, they have the potential for short term adverse effects to stream habitat.

Stream restoration could have short term adverse and beneficial effects to sensitive aquatic macroinvertebrates under alternatives 2 and 3. General stream restoration methods are expected to have only beneficial effects due to lack of ground or vegetation disturbance. Long term benefits of these actions would also occur from plantings and fencing. Heavy mechanical stream restoration would have adverse effects during implementation to species and habitat. The sediment plume from activities will be most concentrated in the immediate project area and should dissipate within a few hours. The increased stream turbidity may deposit fine sediment on substrate a short distance downstream, encourage invertebrates to move downstream, and alter behavior patterns for a short time. It is anticipated that all project related sediment will be flushed out during the first high flows after project completion. Project design features are expected to prevent sediment inputs from persisting into the future, therefore, long-term negative impacts from sediment or reduced habitat quality are not expected. Stream restoration activities will provide immediate and long-term benefits to habitat such as decreased direct sediment inputs from unstable banks or headcuts, increased habitat complexity and improved riparian areas.

Potential long-term benefits from improved watershed, riparian and stream habitat would contribute to species viability and stability while reducing potential impacts from uncharacteristic fire. While negative effects are mitigated for most activities, short term effects from ML-1 roads, low water crossings and stream restoration would have short term effects to individuals and habitat, but long-term benefits in improved habitat quality. Therefore, the determination for sensitive aquatic macroinvertebrates is, may impact individuals or habitat but would not likely contribute toward federal listing or loss of viability to the population or species for alternatives 2 and 3.

Aquatic macroinvertebrates as a management indicator on the Tonto National Forest would have the effects as described above. According to the draft Tonto Land Management Plan, there are 700 miles of perennial streams within the Forest boundary. Approximately 217 miles (30 percent) of those perennial streams are within the Rim Country project area comprising a measurable habitat area for aquatic macroinvertebrates. Based on available information, 80 percent of streams are meeting state and LMP standards. Alternatives 2 and 3 would result in increased habitat quality long term in up to 30 percent of available habitat from stream restoration and reduced risk of uncharacteristic fire which would contribute to the current forest-wide trend. Therefore, the determination is, may impact individuals or habitat, but would not likely contribute toward Federal listing or loss of viability to the population or species for alternatives 2 and 3.

Table 80. Threatened, endangered, Region 3 sensitive, and Tonto National Forest management indicator species with effects determinations by alternative.

Aquatic species	Status ¹	Alternative 1 (no action) ²	Alternatives 2 and 3 ³
Gila trout	T	NE	LAA-BE
Gila chub and critical habitat	E/ D	NE	NE
Gila topminnow	E	NE	NLAA-BE
Little Colorado spinedace	T	NE	LAA-BE
Little Colorado spinedace critical habitat	D	NE	LAA-BE
loach minnow critical habitat	D	NE	NLAA-BE
spikedace	E	NE	NLAA-BE
spikedace critical habitat	D	NE	NLAA-BE
narrow-headed gartersnake	T	NE	LAA-BE
narrow-headed gartersnake	S	NI	MIIH - BI
narrow-headed gartersnake critical habitat	P	NE	NLAM-BE
Chiricahua leopard frog	T	NE	LAA-BE
Chiricahua leopard frog critical habitat	D	NE	LAA-BE
desert sucker	S	NI	MIIH - BI
Sonoran sucker	S	NI	MIIH - BI
Little Colorado sucker	S	NI	MIIH - BI
headwater chub	S	NI	MIIH - BI
roundtail chub	S	NI	MIIH - BI
northern leopard frog	S	NI	MIIH - BI
roundtail chub	S	NI	MIIH - BI
A net-winged midge	S	NI	MIIH - BI
A stonefly	S	NI	MIIH - BI
Parker's cyloopus riffle beetle	S	NI	MIIH - BI
A mayfly (<i>Fallceon eatoni</i>)	S	NI	MIIH - BI
A mayfly (<i>Moribaetis mimbresaurus</i>)	S	NI	MIIH - BI
A caddisfly (<i>Lepidostoma apache</i>)	S	NI	MIIH - BI
A caddisfly (<i>Lepidostoma knulli</i>)	S	NI	MIIH - BI
A caddisfly (<i>Limnephilus granti</i>)	S	NI	MIIH - BI
Ferris' copper butterfly	S	NI	MIIH - BI
Nokomis fritillary	S	NI	MIIH - BI
California floater	S	NI	MIIH - BI
Aquatic macroinvertebrates	MIS	NI	MIIH - BI

1. Status: E = endangered, T = threatened, D = designated, P = proposed, S = sensitive, MIS = management indicator species.

2. Alternative 1 effects: NE = no effect, NI = no impact

3. Alternative 2 & 3 effects: NLAA = may affect, not likely to adversely affect; LAA = may affect, likely to adversely affect; BE = beneficial effect; MIIH = may impact individuals or habitat, but would not likely contribute toward federal listing or loss of viability to the population or species; BI = beneficial impact.

Rare Plants

Affected Environment

This section details the affected environment and environmental consequences for the threatened, endangered and Southwestern Region Regional Forester’s sensitive plants (hereafter Southwestern Region sensitive plants) within the project area. It establishes the baseline against which the decision maker and the public can compare the effects of the action alternatives.

This section also describes the direct, indirect, and cumulative effects of implementing each alternative on threatened, endangered and Southwestern Region sensitive plants. It presents the scientific and analytical basis for the comparison of the alternatives presented in Alternatives section. The information presented here is part of the Botany and Noxious Weeds Specialist report (USDA FS 2022), which is incorporated by reference.

The Rim Country project area **does not include** any locations or potential habitat for Threatened or Endangered plant species, so no threatened or endangered plant species will be analyzed for this project.

Southwestern Region Regional Forester’s Sensitive Plants

Table 81 displays the Southwestern Region sensitive plants occurring within the project area.

Table 81. Southwestern Region regional forester's sensitive plants found in the project area

Common name	Scientific Name	Forest	ERU/Habitat	Data source	Notes
Villous groundcover milkvetch	<i>Astragalus humistratus</i> var. <i>crispulus</i>	Apache Sitgreaves	Narrow-leaf cottonwood/shrub.	HDMS Data SEINet	These occurrences are in the Rodeo-Chediski Fire (2002) and are in severely disturbed sites.
Arizona bugbane	<i>Actaea (Cimicifuga) arizonica</i>	Coconino, Tonto	Ponderosa pine, Mixed Conifer with Aspen	HDMS, SEINet and Forest Service files.	Arizona bugbane occurs mostly in deep canyons.
Dane thistle	<i>Cirsium parryi</i> ssp. <i>mogollonicum</i>	Coconino	Springs – limited to a few known locations in Dane Springs Canyon and nearby drainages/	Goodwin (2005)	Field notes prepared by Goodwin (2005) provide the most accurate location and condition description for this species.
Hairy clematis (Arizona leatherflower)	<i>Clematis hirsutissima</i> var. <i>hirsutissima</i>	Coconino	Ponderosa pine	FS files	Generally on limestone soils,
Mogollon gleabane	<i>Erigeron anchana</i>	Tonto	Ponderosa pine/willow, ponderosa pine/evergreen oak, mixed conifer frequent fire.	SEINet, HDMS	Rock crevices or ledges on boulders and vertical rock faces, usually in canyons, usually on granite (HDMS 2003)
Rock gleabane	<i>Erigeron saxatilis</i>	Coconino	Ponderosa pine, Mixed Conifer Frequent Fire, narrow-leaf cottonwood/shrub, willow/alder, Mixed Conifer with Aspen	SEINet, HDMS, NRM/TESP	Cliffs or vertical rock faces, usually on Coconino sandstone
Arizona sneezeweed	<i>Helenium arizonicum</i>	Coconino, Apache - Sitgreaves	Ponderosa pine Forest (wet meadows) Apache Sitgreaves Ponderosa pine, Montane subalpine grasslands	SEINet, FS files and local knowledge, NRM/TESP	N/A
Eastwood (Senator Mine) alumroot	<i>Heuchera eastwoodiae</i>	All	Ponderosa Pine Evergreen Oak, (TNF) Mixed Conifer Frequent Fire (TNF) Mixed Conifer with Aspen (TNF, A-S) Cottonwood Shrub (TNF), Ponderosa Pine/Willow (TNF, A-S) and Ponderosa Pine (A-S)	SEINet and HDMS	Specimens for this species on the Coconino National Forest have been reclassified to another species (Folk and Alexander 2015)
Flagstaff beardtongue	<i>Penstemon nudiflorus</i>	Coconino	Ponderosa pine/Gambel oak	HDMS, NRM/TESP	N/A
Blumer's dock	<i>Rumex orthoneurus</i>	All	Fremont cottonwood/shrub, herbaceous, Mixed conifer frequent fire, mixed conifer with aspen, narrow leaf cottonwood/shrub, ponderosa pine/evergreen oak, ponderosa pine/willow and ponderosa pine forest.	SEINet and HDMS	N/A
Bebb's willow	<i>Salix bebbiana</i>	Coconino, Apache-Sitgreaves	Montane willow riparian forest.	SEINet	N/A

Assumptions

The environmental effects disclosed for rare plants are based on the following assumptions:

- All relevant laws, regulations, manual guidance and Forest Service policy relating to management of the resources discussed within are followed during analysis and implementation.
- Management would follow the guidance of the Land Management Plans.
- Silviculture and prescribed burning treatments would be implemented as written in the alternatives and analyzed in the Silviculture and Fire Ecology and Air Quality specialist reports and not substantially modified without review of the effects of such activities.
- Management activities related to roads and transportation as well as spring and channel restoration would be implemented as addressed in their respective reports and not substantially modified without review of the effects of such activities.
- Prescribed fires would be of lower severity in any given area compared to large-scale wildfires in the same area so the amount of disturbance from prescribed burning is less than compared to wildfires.
- Fire effects to individual species vary depending on several factors including life cycle, time of burning and several biotic and abiotic factors (Pyke et al 2010). As a result, the responses of the plant species discussed may vary in any given area or time. The effects of fire on these species would be mitigated through the burning prescription.
- Areas to be treated would be surveyed for Southwestern Region sensitive plants before and after treatments are implemented. These factors should be considered when identifying survey needs
- Target special features and microhabitat needed by the species of interest. This is generally only a small portion of the area and is estimated to be 5 percent or less of any given area.
- Survey and mitigation would be based on the likelihood of any of the species addressed in this document occurring within the project area. Not all areas contain suitable habitat for a given species.
- The amount of disturbance predicted to occur during treatment. For example, surveys may not be needed in areas scheduled for prescribed burning if the treatments are scheduled to be of low intensity.
- Areas to be treated would be surveyed for noxious or invasive weeds before and after treatments are implemented. These factors should be considered when identifying survey needs
- Likelihood of any of the species addressed in this document occurring within the project area.
- Amount of disturbance. For example, surveys may not be needed in areas scheduled for prescribed burning if the treatments are scheduled to be of low intensity.
- Application of the design features, best management practices, and mitigation and conservation measures discussed in the Rare Plants section of chapter 3 and in appendix C are included in analysis and project implementation.
- The acreage of potential disturbance in this project is much larger than generally analyzed in similar projects, necessitating more noxious or invasive weed treatments to control invasive species.

Indicators/Topics of Analysis

The indicators used to evaluate environmental consequences are:

1. How would proposed treatments affect Southwestern Region sensitive plant species?
2. How would project activities affect interactions between noxious or invasive weeds and Southwestern Region sensitive plants?
3. A unit of measure for Southwestern Region sensitive plant species is to maintain or increase the populations within the project area. Additionally, potential habitat for these species should be maintained or enhanced.
4. A qualitative evaluation of whether populations are maintained or increased per FSM 2670.5(19)
5. A qualitative evaluation of whether potential habitat is maintained or enhanced.
6. An evaluation of whether effects on sensitive plants and their habitats are effectively minimized.
7. An evaluation on habitat and species resiliency to natural disturbances including fire and climate change.

Environmental Consequences

Alternative 1 – No Action

Southwestern Region Regional Forester's Sensitive Plants

Direct and Indirect Effects common to all species

Alternative 1 is the no action alternative. This alternative would not address the purpose and need for the Rim Country Project and would not provide any progress toward the improved conditions addressed in each of the three forest's Land Management Plans.

Specifically, portions of the purpose and need that would improve habitat for these species would not be addressed.

- There would be no increase in forest resiliency and sustainability.
- The risk of uncharacteristic fire effects would not be reduced.
- Habitat for wildlife and aquatic species would not be improved.
- Conditions and function of streams and springs would not improve.
- There would be no opportunity to restore woody riparian species, including Bebb's willow.

There would be no tree cutting and no prescribed burning, so no reduction in, tree density. Tree canopy would not be reduced. Conditions associated with dense ponderosa pine stands result in physiologically stressful environments for understory plants. Stressors include increased shading, deep litter horizons, low soil moisture, low nutrient availability and contribute to a decline in species richness within the plant community (Laughlin et al. 2011). These factors affect all understory species including Region 3 sensitive plants. There would continue to be a reduction or loss of understory vegetation and therefore, a loss of understory services.

With no treatment, fire hazard would continue to increase therefore increasing the risk of severe wildfire in many parts of the project area (see Vegetation and Fire Reports for more information). Factors that contribute to fire hazard ratings that would be reduced through management actions such as canopy cover, trees per acre and dead and down fuel loading would not be reduced. The risk of wildfire transitioning to

crown fires would increase in many areas of the project area resulting in the increased risk of severe wildfire and degradation of potential habitat. Severe wildfires often result in short and long-term effects, which include removal of tree canopy, loss of the understory plant community and alteration of soil structure and nutrients (Pyke et al. 2010, Springer and Egan 2012). These changes could adversely affect the habitat and populations of Region 3 sensitive plants by damaging soil, killing existing plants and by reducing or destroying the seed bank. Fire size may also increase, leading to largescale crown fires, which in turn may cause a permanent loss in understory diversity (Covington 2000, Springer, et al. 2018). Primary fire effects such as loss of individual plants or groups may recover in a matter of a few years. However, secondary effects such as permanent changes in biotic and abiotic factors can result in permanent changes in the post fire plant community (Pyke et al. 2010, Springer and Egan 2012).

There would be no opportunities to improve the condition and function of streams and springs so opportunities to improve habitat for such species as Arizona sneezeweed, Bebb's willow and Blumer's dock would not occur and areas that might have historically provided habitat for these species and would remain degraded and unsuitable for these and other plant species that require mesic conditions for their survival.

With no action, there would be no restoration of structure and function in the treatment areas, resulting in continued departure from the desired conditions for all resources in this project, including Region 3 sensitive plant species.

If alternative 1 is selected management actions such as fuels reduction projects, prescribed fire, spring and channel restoration would be limited to those analyzed and implemented by the individual projects analyzed in other NEPA on each forest.

Determination of Effects

Alternative 1 would not impact individuals of any of the Region 3 sensitive plant species discussed in this analysis and is not likely to result in a trend toward federal listing or loss of viability. This is because no management actions would occur as a result of this project.

Effects Common to Alternatives 2 and 3

Villous groundcover milkvetch (Astragalus humistratus var. crispulus)

Villous groundcover milkvetch is a Region 3 sensitive species for Apache Sitgreaves NF. Its distribution is limited to southeastern Apache County in Arizona and in neighboring Catron County in New Mexico where it grows on sandy soils of volcanic origin in dry pine forests (Spellenberg 2007). The occurrences on the forest are in narrow-leaf cottonwood/shrub ERUs.

Direct and Indirect Effects

The known occurrences of villous ground cover milkvetch are in areas proposed for stream channel restoration on the Apache-Sitgreaves National Forests. The project activities would help move the treated areas toward the desired conditions as described in the Apache-Sitgreaves LMP including mitigating the landscape scale disturbance that occurred as a result of the Rodeo-Chediski Fire in 2002.

The plant locations were documented in 2014 so are present despite the disturbance from the fire. No scientific data or publications were found that document the effects of fire on the plant. Villous groundcover milkvetch has been observed growing in roadbeds so is assumed to tolerate disturbance (Spellenberg 2007) so would likely tolerate the burning treatments proposed for these areas. Mitigations such as BT003 that addresses disturbance would help reduce the risk of prescribed fire treatments.

Management activities related to stream restoration could result in the damage or loss of individual plants or groups of plants at the two known locations. This can be mitigated by following the guidelines for wildlife and rare plants in the land management plans, stating that modifications, mitigations, or other measures should be incorporated to reduce negative impacts to plants, animals, and their habitats and to help provide for species needs, consistent with project or activity objectives.

The management activities needed to restore the stream channels would be guided by the Aquatic Condition-based Management approach which would also mitigate the loss of plants. It is anticipated that the tools for improving the form and function of stream channels and floodplains (see appendix D of FEIS) and the tools for improving spring outflows would be used at these sites. Mitigations such as AQ020, BT005, and BT007 would reduce the risk of management actions to the Southwestern Region sensitive plants at these sites.

Cumulative Effects

The timeframe for analysis of cumulative effects on villous groundcover milkvetch is from 2002 when the Rodeo-Chediski Fire burned through the area to 20 years in the future. The area of this analysis is the project boundary. The degraded channels in the area may be attributed at least in part to the effects of the Rodeo-Chediski Fire in the areas around the occurrences of villous groundcover milkvetch as well as in the watersheds above and attributed to the need for action to restore these channels.

The effects of recreation on the plants at Black Canyon Lake when added to the effects of implementing the activities proposed in the Rim Country Project may contribute to the impacts to the villous groundcover milkvetch in the area.

Other documented occurrences of villous groundcover milkvetch are within the Heber Wild Horse Territory. Desired conditions for this area include grazing that is in balance with the available forage. It is not known if horses or other grazers in the area utilize villous groundcover milkvetch as forage so cumulative effects are also unknown.

Determination of Effect

Implementation of alternatives 2 or 3 may impact individuals of villous groundcover milkvetch (*Astragalus humistratus* var. *crispulus*) but is not likely to result in a trend toward federal listing or loss of viability.

Dane (Mogollon) thistle (Cirsium parryi subsp. mogollicum)

Dane thistle is a Region 3 sensitive species for Coconino National Forest. It is endemic to a few canyons on the Mogollon Rim Ranger District.

Direct and Indirect Effects

The known range of Dane thistle is a small portion of the overall project area. At least one occurrence of Dane thistle was protected with a small wire structure in the past, but this area has not been revisited in several years, so the fates of the plants and structure are unknown. Two occurrences of Dane thistle are within the Coyote Springs Mexican spotted owl protected activity center. The third occurrence is outside the Coyote Springs protected activity center in recovery habitat. The most significant risk to Dane thistle from this treatment is direct losses of individuals from management actions and these can be mitigated by using design features and mitigations such as BT005, BT006, and BT007.

Short-term effects of prescribed fire include loss of individual plants. The potential long-term effects include the loss of shade, increased risk of noxious or invasive weeds and an increased risk of erosion. This would be mitigated by burning at intensities in all entries low enough to limit mortality to trees and other vegetation to the extent possible.

The management activities would help move the treated areas toward the desired conditions. The effects of disturbance from vegetation treatments and prescribed fire include loss of individual plants.

Aquatic restoration includes site disturbing activities that would affect the occurrences of Dane thistle, especially the northernmost occurrence which is less than 1/10th mile from a proposed restoration site. Ground-disturbing activities such as moving soil would increase the risk of disturbance to individual plants and their habitat. These effects would be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

There are no rock pits or in-woods processing areas near Dane thistle so effects from management activities associated with rock pits or in-woods processing sites would occur.

The locations of Dane thistle are not near any roads so there are no effects from management actions along roads.

Cumulative Effects

The area of this cumulative effects analysis includes the known range of Dane thistle. The timeframe begins when Dane thistle was first described in 1990 to twenty years in the future.

There have been a variety of management activities in the uplands surrounding the known Dane thistle occurrences but few activities have occurred in the steep canyon areas. Grazing by cattle has occurred in the past but the allotment containing Dane thistle is not currently being used. Grazing by wildlife still occurs. A limited amount of recreational activities such as hiking may occur in the areas but there are no established trails in the canyon areas.

There is a large, dispersed camping area in the uplands above one occurrence. A fence restricts vehicle travel and camping near the canyon edge. Hikers from the camping area may occasionally venture into the area. At the same site, there is an historical cabin and spring diversion upslope. Through another project there are plans to rehabilitate the spring, allowing it to be free flowing but management actions from this action are not anticipated to have any effect on Dane thistle.

In addition to the management actions in this analysis, grazing by wildlife and recreation would continue in this area.

Non-native invasive species such as bull thistle (*Cirsium vulgare*) are threats to rare species such as Dane thistle for resources such as water and light. Mitigation to prevent infestations in these areas is especially important.

Cumulatively, the loss of individual plants may occur when added to the loss of plants as a result of grazing, creation and other prescribed fire or mechanical treatments implemented within the cumulative effects boundary.

Determination of Effect

Implementation of alternative 2 or 3 may impact individuals of Dane thistle (*Cirsium parryi* ssp *mogollonicum*) but is not likely to result in a trend toward federal listing or loss of viability.

***Mogollon fleabane* (*Erigeron anchana*)**

Mogollon fleabane is a Region 3 sensitive species for Tonto National Forest where it grows in cliff faces and rocky area.

Direct and Indirect Effects

Treatments in the area of known occurrences of Mogollon fleabane include mechanical and prescribed fire treatments. The area is also near a stream channel proposed for aquatic restoration.

The vegetation and prescribed fire treatments would support the management emphasis for Mogollon fleabane, and the vegetation treatments would reduce the risk of uncharacteristic disturbances and would improve watershed condition. Prescribed fire would reduce the risk of uncharacteristic fire in the area surrounding this occurrence of Mogollon fleabane and move toward allowing fire to resume its natural ecological role.

Aquatic restoration may include site disturbing activities that would affect this occurrence of Mogollon fleabane. Ground disturbing activities such as moving soil would increase the risk of disturbance to individual plants and their habitat. These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible. See mitigation BT007.

The known occurrence of Mogollon fleabane is near the Bear Flat Campground near roadway so the species may be affected if construction, maintenance or reconstruction of the road occur, especially if the rocky areas favored by the species is affected. This can be mitigated by locating and avoiding the plants before activities occur. See mitigation BT007.

There are no rock pits or in-woods processing areas near this occurrence of Mogollon fleabane so no effects would occur.

Cumulative Effects

The timeframe of this discussion of cumulative effects on Mogollon fleabane is from 1990 to 20 years in the future. The area of this analysis is the project boundary. Many known locations of Mogollon fleabane are in wilderness or remote areas and would not be affected by management activities such as those proposed in this project.

Related to the known occurrence in the project area near the Bear Flat Campground, past and future impacts from recreational activities have occurred and would continue to occur near the site. Recreational activities such as rock climbing could also affect plants by crushing individuals and altering habitat.

Factors contributing to the degradation of Tonto Creek may have impacted Mogollon fleabane. Cumulatively aquatic habitat restoration activities, would help to conserve or improve the habitat of Mogollon fleabane in this area.

The past actions such as construction and maintenance of roads in the area would have contributed to the effects on habitat in this area, especially if rock formations were altered during construction and maintenance.

In addition to the management activities in this project, the foreseeable actions in area include recreation and occupancy of nearby land. Grazing by cattle and wildlife may occur in the area. Wildfire may also occur in the area. These may affect the habitat or plants occurring at this location but are not likely to affect the entire species.

Determination of Effect

Implementation of alternative 2 or 3 may impact individuals of Mogollon fleabane (*Erigeron anchana*) but is not likely to result in a trend toward federal listing or loss of viability.

Eastwood (Senator Mine) Alumroot (*Heuchera eastwoodiae*)

Eastwood Alumroot is a Region 3 sensitive species for all three forests. Eastwood alumroot is endemic to central Arizona where it grows on moist shaded slopes in ponderosa pine forests and canyons. The typical substrate is crevices in basalt soil or basalt soil (Arizona Game and Fish Department 2005).

Direct and Indirect Effects

There is one occurrence of Eastwood alumroot in an area slated for mechanical treatment. The effects of mechanical treatment include loss of individual plants or groups of plants.

Prescribed fire would occur in the project area. Short-term effects of prescribed fire include loss of individual plants. The potential long-term effects include increased risk of noxious or invasive weeds and an increased risk of erosion. Mitigation BT003 would reduce the risk from prescribed fire.

Hunter and Christopher Creeks are slated for riparian restoration. The risk to Eastwood alumroot from these actions include loss or damage of plants or loss of habitat. Ground disturbing activities such as moving soil would increase the risk of disturbance to individual plants and their habitat. These effects can be mitigated through design features mitigate loss of sensitive plants by avoiding them as much as possible.

An indirect effect of management actions within the potential habitat of Eastwood alumroot includes an increased risk of invasion from noxious or invasive weeds. Incorporation of the design features, best management practices, mitigation and conservation measures in appendices C and D would mitigate these effects.

There are no rock pits or in-woods processing areas near this occurrence of Eastwood alumroot so no effects would occur.

Cumulative Effects

The area of consideration for this discussion is the project area boundary. The timeframe includes 20 years past and future. Although this species occurs on all three forests within the project area, no data were found to document the effects of management on the species. Several of the areas where Eastwood alumroot occurs are in remote areas and/or in wilderness areas such as the Sierra Ancha, Red Rock Secret Mountain, and Mazatzal Mountains where no management activities would occur. Past impacts to basalt soils and crevices, especially in canyons and drainage areas may have affected individuals, groups or habitat for Eastwood alumroot. Dispersed recreation, especially activities such as canyoneering and rock climbing occur in potential habitat for Eastwood alumroot.

Determination of Effect

Implementation of alternative 2 or 3 may impact individuals of Eastwood (Senator Mine) alumroot (*Heuchera eastwoodiae*) but is not likely to result in a trend toward federal listing or loss of viability.

Blumer's Dock (*Rumex orthoneurus*)

Blumer's dock is a Southwestern Region sensitive species for all three forests. Blumer's dock is a large, long-lived herbaceous perennial plant endemic to New Mexico and Arizona. Its range is from east-central to southeastern Arizona (depending on taxonomic interpretation). Habitat for Blumer's dock includes mid- to high-elevation wetlands with moist, organic soil adjacent to perennial springs or streams in canyons or meadows (Arizona Game and Fish Department 2002).

Direct and Indirect Effects

Most of the occurrences of Blumer's dock occur in areas scheduled for riparian restoration, with some in areas where wet meadow restoration is planned. The risk to Blumer's dock from management actions to restore aquatic habitats and stream channels include loss or damage of plants or loss of habitat. Ground disturbing activities such as moving soil would increase the risk of disturbance to individual plants and their habitat. These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible. An indirect effect of management actions within the potential habitat of Blumer's dock includes an increased risk of invasion from noxious or invasive weeds. Prescribed fire would occur in the project area. Short-term effects of prescribed fire include loss of individual plants but these can be mitigated by using design features. There are no rock pits or in-woods processing areas near the occurrences of Blumer's dock so no effects would occur. Blumer's dock may occur near roadways so may be affected if construction, maintenance or reconstruction of the road occurs and can be mitigated by locating and avoiding the plants before activities occur.

Cumulative Effects

The area of consideration for this discussion includes the portion of the project area containing Blumer's dock plants and habitat, especially the drainages in the area. The timeframe is from 1993 to 20 years in the future. The 1993 timeframe was chosen to allow inclusion of introductions of Blumer's dock on the Apache-Sitgreaves and Tonto National Forests as documented in the Conservation Strategy. These introductions were implemented to supplement the numbers of plants and populations of this rare species. The fates of many of these introductions are unknown but are not thought to have persisted. This would affect the distribution of Blumer's dock in the project area and could affect the mitigations and management actions for restoring these areas. A series of exclosures on Apache-Sitgreaves National Forests protects some of these sites.

Several large fires have occurred in the project area. The largest of these is the Rodeo-Chediski (2002). It and other large fires have affected the terrestrial and aquatic habitats in the area containing Blumer's dock by destroying or altering vegetation communities, creating landscape scale disturbance, contributing to the risk of invasion of noxious or invasive weeds and contribution to erosion.

Grazing by livestock and wildlife has occurred and would continue to occur in the area. Blumer's dock is palatable to animals and small populations may be completely eaten in a single year. Activities such as dispersed recreation and firewood gathering have occurred and would continue to occur in the area.

Determination of Effect

Implementation of alternative 2 or 3 may impact individuals of Blumer's dock (*Rumex orthoneurus*) but is not likely to result in a trend toward federal listing or loss of viability.

Alternative 2 – Modified Proposed Action

Arizona Bugbane (Cimicifuga arizonica)

Arizona bugbane is a Region 3 sensitive species for Kaibab, Coconino, and Tonto National Forests. In this analysis occurrences of Arizona bugbane are limited to the Coconino National Forest. There are no known occurrences of Arizona bugbane within the project area for Tonto National Forest. Arizona bugbane is endemic to northern Arizona where it occurs in mesic habitats, typically along the bottoms and lower slopes of steep, narrow canyons. The overstory often includes a combination of coniferous and deciduous tree species. The habitat is similar to that favored by Mexican spotted owls.

Direct and Indirect Effects

The proposed management actions would help move the treated areas toward the desired conditions as described in the land management plan. The most significant effect to Arizona bugbane from management actions is direct losses of individuals from management actions but these would be mitigated through the design features in appendix C of the FEIS.

This occurrence of Arizona bugbane is within the Tom's Creek Mexican spotted owl protected activity center. Treatments for individual protected activity centers would be discussed with FWS.

Trees removed from areas in this treatment are generally smaller in diameter than those removed in other treatments. Canopy cover after treatment is generally higher as compared to those prescribed using the mechanical toolbox for areas outside Mexican spotted owl habitat. Shade for Arizona bugbane plants in this area may be affected but it would not be extensive. This could result in the loss of a few individuals but would not affect the entire population at this site.

Short-term effects of prescribed fire include loss of individual plants. The potential long-term effects include the loss of shade, increased risk of noxious or invasive weeds and an increased risk of erosion. This would be mitigated by burning at intensities in all entries low enough to limit mortality to trees. The current knowledge of fire effects on Arizona bugbane are based largely on observations on a local wildfire, the Fry Fire in 2003.

No hauling is proposed in the immediate area of Arizona bugbane populations. Indirect effects from road use would be limited to dust from road maintenance but these would be minimal and inconsequential.

An indirect effect of management actions within the potential habitat of Arizona bugbane includes an increased risk of invasion from noxious or invasive weeds. Incorporation of the design features in appendix C of the FEIS would mitigate the effects of increased disturbance from management activities and help to control the spread and introduction of weeds within the habitat of Arizona bugbane.

No locations of Arizona bugbane occur within sites for spring or channel restoration, so there are no effects to the species.

There are no rock pits or in-woods processing areas near this occurrence of Arizona bugbane so no effects would occur.

Cumulative Effects

The following past actions have affected the abundance of Arizona bugbane and have established baseline current condition for Arizona bugbane; grazing, recreation, wildfire, and natural disturbances such as flooding, drought, tornados and mortality in overstory trees. Grazing impacts were addressed in the Conservation Assessment and Strategy for the Coconino and Kaibab National Forests and included fencing and monitoring in certain populations which led to a reduction in these conflicts.

In addition to the management actions in this analysis, the foreseeable activities in area include recreation such as hiking, rock climbing and canyoneering. Grazing by cattle and wildlife would continue. Wildfires may also occur in the area. None of these activities would eliminate Arizona bugbane at the site. Cumulatively, the effects from activities from this project when added to effects from other projects would also not eliminate bugbane at this site.

Determination of Effect

Implementation of alternative 2 may impact individuals of Arizona bugbane (*Cimicifuga arizonica*) but is not likely to result in a trend toward Federal listing or loss of viability.

Hairy Clematis (Arizona leatherflower) (Clematis hirsutissima var. hirsutissima) (syn. var. Arizona)

Hairy clematis is a Southwestern Region sensitive species for Coconino National Forest where it occurs in ponderosa pine forests. There is one location of hairy clematis in a unit proposed for stream channel restoration.

Direct and Indirect Effects

The area containing hairy clematis is slated for mechanical treatment. The effects of mechanical treatment include loss of individual plants or groups of plants. These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

Short-term effects of prescribed fire include loss of individual plants. The potential long-term effects include the loss of shade, increased risk of noxious or invasive weeds and an increased risk of erosion. These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

Activities associated with roads and transportation in this project would be limited those needed to accomplish the management actions that would occur in the area. Effects to plants can be mitigated by locating and avoiding them (appendix C of the FEIS). An indirect effect of management actions within the potential habitat of hairy clematis includes an increased risk of invasion from noxious or invasive weeds. There are no rock pits or in-woods processing areas near this occurrence of hairy clematis so effects from management activities associated with rock pits or in-woods processing sites would occur.

Cumulative Effects

The area of this analysis is the project boundary. The time frame is from 2005 to 10 years in the future, which is considered the length of the decision to be made by this analysis.

One occurrence was detected in 2005 during a survey for the Bald Mesa Fuels Reduction Project. Since then there has been at least one entry of prescribed fire in this area. The effects were mitigated by locating and constructing hand line around the plants. Other activities include grazing and dispersed recreation in the uplands.

In addition to the management actions in this analysis, the foreseeable actions within the habitat of hairy clematis include recreation such as hiking and dispersed camping. Wildfires may burn in the area. Grazing by cattle and wildlife would continue. None of these actions would eliminate the hairy clematis at the site.

Determination of Effect

Management actions proposed in the Rim Country EIS may impact individuals of hairy clematis (*Clematis hirsutissima* var. *hirsutissima*) (syn. var. *Arizona*) but is not likely to result in a trend toward Federal listing or loss of viability.

Rock (cliff) fleabane (Erigeron saxatilis)

Rock fleabane is a Region 3 sensitive species for Coconino National Forest. All known occurrences are limited to the Coconino National Forest.

Rock fleabane is a small daisy-like plant that tends to grow in erosion pockets on vertical cliff faces, most commonly Coconino sandstone. Generally, risks from management activities are confined to activities that would affect the cliff habitat on which it depends.

Direct and Indirect Effects

Two areas containing rock fleabane are slated for mechanical treatment. The effects of mechanical treatment include loss of individual plants or groups of plants. These effects would be mitigated by using the design features (BT001, BT005, BT006, and BT007) in appendix C.

Prescribed fire would occur throughout the project area but rock fleabane tends to occur in rocky areas that are sheltered from most fire activities so effects to the species from burning are anticipated to be minimal. Management activities such as fire line construction are not likely to occur in these areas. Short-term effects of prescribed fire include loss of individual plants. Design feature BT003 applies to prescribed fire where Southwestern Region sensitive plants occur. There are two occurrences of rock fleabane in aquatic restoration areas. The risk to rock fleabane from management actions include loss or damage of plants or loss of habitat. Ground disturbing activities such as moving soil would increase the risk of disturbance to individual plants and their habitat. These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

An indirect effect of management actions within the potential habitat of rock fleabane includes an increased risk of invasion from noxious or invasive weeds incorporation of the design features, in appendices C and D would mitigate the effects of increased disturbance from management activities, and help to control the spread and introduction of weeds within the habitat of rock fleabane.

Two occurrences of rock fleabane appear to be near roadways so may be affected if construction, maintenance or reconstruction of the road occurs, especially if the rocky areas favored by the species is affected.

Factors contributing to the degradation of aquatic habitats that led to the decision to include the areas in this analysis may have also affected the habitat of rock fleabane. Aquatic habitat restoration, depending on the actions taken could preserve or improve the habitat of rock fleabane in this area, depending on the actions taken by restoring the general area and reducing effects such as erosion in the long term.

There are no rock pits or in-woods processing areas near this occurrence of rock fleabane so no effects would occur.

These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

Cumulative Effects

The timeframe considered is from 1990 to 20 years in the future. The area of this analysis is the project boundary.

Factors contributing to the degradation of areas scheduled for aquatic restoration that led to the decision to include it in this analysis may have also affected the habitat of rock fleabane. Aquatic habitat restoration, depending on the actions taken could preserve or improve the habitat of rock fleabane in this area.

The past actions such as construction and maintenance of roads in the area could have contributed to the effects on habitat in this area, especially if rock formations were altered during construction and maintenance.

In addition to the management actions in this analysis, grazing by cattle and wildlife may occur in the area. Wildfire may also occur in the area. These may affect the habitat or plants occurring at this location but are not likely to affect the entire species.

Determination of Effect

Implementation of alternatives 2 or 3 may impact individuals of rock fleabane (*Erigeron saxatilis*) but is not likely to result in a trend toward federal listing or loss of viability.

Arizona sneezeweed (*Helenium arizonica*)

Direct and Indirect Effects

Arizona sneezeweed occurs on all three forests included in this analysis and within several treatments.

Short-term effects of prescribed fire include loss of individual plants. The potential long-term effects include the loss or damage of plants, increased risk of noxious or invasive weeds and an increased risk of erosion.

An indirect effect of management actions within the potential habitat of Arizona sneezeweed includes an increased risk of invasion from noxious or invasive weeds. Incorporation of the design features in appendix C of the FEIS would mitigate the effects of increased disturbance from management activities, and help to control the spread and introduction of weeds within the habitat of Arizona sneezeweed.

Arizona sneezeweed is known to occur in the following aquatic restoration units; Woods Canyon Creek, Chevelon Lake and Canyon Creek but may be in additional sites as well. Aquatic restoration may include site disturbing activities that would affect Arizona sneezeweed. Ground disturbing activities such as moving soil would increase the risk of disturbance to individual plants and their habitat. These effects can be mitigated through design features (found in appendix C of FEIS) to mitigate loss of sensitive plants by avoiding them as much as possible.

Arizona sneezeweed near roadways may be affected if construction, maintenance or reconstruction of the road occurs, especially if the rocky areas favored by the species is affected. This can be mitigated by locating and avoiding the plants and through other mitigations in appendix C of FEIS.

There are no rock pits or in-woods processing areas near this occurrence of Arizona sneezeweed so effects from management activities associated with rock pits or in-woods processing sites would occur.

Arizona sneezeweed may occur near roadways so may be affected if construction, maintenance or reconstruction of the road occurs and can be mitigated by locating and avoiding the plants before activities occur and by using the mitigations found in appendix C of FEIS.

Cumulative Effects

The timeframe considered is from 1999 when Arizona sneezeweed was added to the sensitive species list to 20 years in the future. The area of this analysis is the project boundary.

On the Coconino National Forest, Arizona sneezeweed has been addressed in Upper Beaver Creek Watershed Fuel Reduction (2010), Clint's Well Forest Restoration (2013) and the Cragin Watershed Protection Project (2018), in which effects were mitigated through design features and mitigations similar to those proposed in this project. The finding of effect for all these projects was "may effect". To date, none of these projects has been fully implemented. Therefore, the effects of the projects on Arizona sneezeweed including those that would be beneficial to the species have not been fully realized.

Arizona sneezeweed tends to grow in drainages and open areas. These areas are also favored by dispersed recreationists who may crush plants and alter habitat during activities. Activities such as grazing and fuelwood gathering have occurred and would continue in these areas.

Factors contributing to the degradation of aquatic habitats that led to the decision to include the areas in this analysis may have also affected the habitat of Arizona sneezeweed. Aquatic habitat restoration, depending on the actions taken could preserve or improve the habitat of Arizona sneezeweed in this area, depending on the actions taken by restoring the general area and reducing effects such as erosion in the long term.

Determination of Effect

Implementation of alternatives 2 or 3 may impact individuals of Arizona sneezeweed (*Helenium arizonicum*) but is not likely to result in a trend toward federal listing or loss of viability.

Flagstaff beardtongue (*Penstemon nudiflorus*)

Flagstaff beardtongue is a Southwestern Region sensitive species for Coconino National Forest. Flagstaff beardtongue grows in dry pine forests, pine/oak, pine/oak/ juniper and pinyon juniper forests.

Direct and Indirect Effects

Most of the areas containing Flagstaff beardtongue receiving vegetation treatments areas are proposed for mechanical treatment. The effects of mechanical treatment include loss of individual plants or groups of plants.

Prescribed fire would occur across the project area. Short-term effects of prescribed fire include loss of individual plants. The potential long-term effects include the loss of shade, increased risk of noxious or invasive weeds and an increased risk of erosion.

An indirect effect of management actions within the potential habitat of Flagstaff beardtongue includes an increased risk of invasion from noxious or invasive weeds.

Activities associated with roads and transportation in this project would be limited to those needed to accomplish the management actions that would occur in the area.

These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

There are no rock pits or in-woods processing areas near the occurrences of Flagstaff beardtongue so there would be no effects from these management activities associated with rock pits or in-woods processing sites.

Cumulative Effects

The area of consideration for this discussion includes the Coconino National Forest within the analysis area boundary. The timeframe includes 20 years past and future.

Flagstaff beardtongue occurs on several of past projects that addressed vegetation and prescribed fire treatments. These include Upper Beaver Creek Watershed Fuel Reduction (2011), Clint's Well Forest Restoration, Lake Mary Road ROW Clearing (ADOT) (2016) and the 1st 4FRI EIS. Effects to Flagstaff beardtongue were mitigated with similar measures as those proposed in this FEIS. None of these projects have been fully implemented so the effects to Flagstaff beardtongue, including those that could be beneficial are not fully realized.

Management activities such as grazing have occurred and would continue to occur in the area of consideration. Other activities such as utility corridors have impacted individual plants or groups but has not substantially affected the species as a whole. Activities such as dispersed recreation and fuel wood cutting occur in the area of consideration. Flagstaff beardtongue is showy and is cultivated and offered for

sale by local and regional wildflower vendors. The effects of activities such as collection of seeds or plants on wild populations is not known.

Determination of Effect

Implementation of alternative 2 may impact individuals of Flagstaff beardtongue (*Penstemon nudiflorus*) but is not likely to result in a trend toward federal listing or loss of viability.

Bebb's Willow (Salix bebbiana)

Bebb's willow is a Region 3 sensitive species for Apache-Sitgreaves and Coconino National Forests. It occurs in several areas containing riparian habitat within the project area.

Direct and Indirect Effects

Some of the areas containing Bebb's willow would receive vegetation treatments. The effects of mechanical treatment include loss of individual plants or groups of plants. These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible (appendix C of FEIS). The risk to Bebb's willow from management actions to restore aquatic habitats and stream channels include loss or damage of plants or loss of habitat. These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible.

Ground disturbing activities such as moving soil would increase the risk of disturbance to individual plants and their habitat. These effects can be mitigated through design features and mitigations to minimize the loss sensitive plants by avoiding them as much as possible.

Prescribed fire would occur in the project area. The effects of prescribed fire include loss of individual plants. These effects can be mitigated through design features to mitigate loss of sensitive plants by avoiding them as much as possible. The effects of prescribed fire can be mitigated by using design feature FE005.

An indirect effect of management actions within the potential habitat of Bebb's willow includes an increased risk of invasion from noxious or invasive weeds. Incorporation of the design features in appendix C of FEIS.

There are no rock pits or in-woods processing areas near the occurrences of Bebb's willow so no effects would occur.

Bebb's willow may occur near roadways so may be affected if construction, maintenance or reconstruction of the road occurs and can be mitigated by locating and avoiding the plants before activities occur.

Cumulative Effects

The area of consideration for this discussion includes the portion of the project area containing Bebb's willow and its habitat, especially the drainages in the area. The timeframe is 20 years past and in the future.

There are a series of exclosures on the Apache-Sitgreaves National Forests and Coconino National Forest. Some of contain, or were designed to protect, Bebb's willows. The status of these is unknown.

Several large fires have occurred in the project area. The tops of Bebb's willow may be removed by fire but the species is able to regenerate through basal sprouting. However, regeneration is often targeted and eaten by domestic and wild grazers, leading to depletion of underground reserves ultimately leading to the loss of plants in areas of heavy grazing pressure.

Grazing by livestock and wildlife has occurred and would continue to occur in the area. Bebb's willow is palatable to animals and small populations may be completely eaten in a single year. Activities such as dispersed recreation and firewood gathering have occurred and would continue to occur in the area.

Determination of Effect

Implementation of alternative 2 or 3 may impact individuals of Bebb's willow (*Salix bebbiana*) but is not likely to result in a trend toward Federal listing or loss of viability.

Alternative 3 – Focused Alternative

Arizona Bugbane (Cimicifuga arizonica)

Under alternative 3, no mechanical treatments would take place in the area where Arizona bugbane is known to occur, so the effects of mechanical treatment described in alternative 2 above do not apply. The reduction of canopy closure and reduction of stand densities would not occur in this alternative. The effects on Arizona bugbane of all other management actions are similar to those described above in the discussion of effects of alternative 2.

Hairy Clematis (Arizona leatherflower) (Clematis hirsutissima var. hirsutissima) (syn. var. Arizonica)

In alternative 3, no mechanical or fire treatments are proposed in areas where hairy clematis is known to occur so the effects of those actions are similar to alternative 1, the no action alternative. The effects of transportation and channel restoration are the same as those discussed for alternative 2, above, including the threats of noxious or invasive weeds.

Rock (cliff) fleabane (Erigeron saxatilis)

One occurrence of rock fleabane (in the Barbershop Mexican spotted owl protected activity center) would not receive mechanical and/or prescribed fire treatments in this alternative and would not move as quickly toward desired condition as compared to the potential Mexican spotted owl protected activity center treatment in alternative 2. Two occurrences that would be treated as Mexican spotted owl habitat in alternative 2 would receive different mechanical treatments in this alternative. One area would receive an individual tree removal and the other would be treated using an uneven age thinning treatment. Both would receive some form of prescribed burning. The effects of these treatments may result in different overstory composition and structure but the effects to rock fleabane and its habitat are expected to be similar.

Arizona sneezeweed (Helenium arizonicum)

Fewer areas containing Arizona sneezeweed would be treated as compared to alternative 2. As a result, alternative 3 would not fulfill the purpose and need of the project as well as alternative 2 and there would be less progress toward the desired conditions of the forest LMRPs, including those that apply to Southwestern Region sensitive plants such as Arizona sneezeweed.

Flagstaff beardtongue (Penstemon nudiflorus)

Under alternative 3, few acres containing Flagstaff beardtongue would receive vegetation treatments. Alternative 3 would not address the purpose and need to the extent that alternative 2 would. There would be less progress toward the desired conditions that affect Flagstaff beardtongue. Forest resilience would be attained on fewer acres and the risk of undesirable fire effects would be reduced in fewer areas. Flagstaff beardtongue plants and habitat in these untreated areas would remain at higher risk of loss.

Bebb's Willow (Salix bebbiana)

Fewer areas containing Bebb's willow would receive vegetation or prescribed fire treatments as compared to alternative 2. As a result, it would not fulfill the purpose and need of the project to the extent that alternative 2 would and there would be less progress toward the desired conditions including those that apply to Southwestern Region sensitive plants such as Bebb's willow.

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